ENGINEERING NEWS

——THE MERCHANT'S BRIDGE across the Mississippi at St. Louis, seems to be an assured fact. The *Globe-Democrat* says that a bid has been received and accepted from a bridge company fixing the cost of the bridge complete, including abutments, piers and superstructure at $7,500,000. As described the bridge will be 2,425 ft. long, with 3 spans of about 522 ft. each and 6 spans of 125 ft. each, with the bottom chord 52 ft. above city datum. The piers will be of masonry founded on pneumatic caissons. The President of the company is SETH A. COBB.

——THE CHARLES RIVER BRIDGE AND THE WARREN BRIDGE, across the Charles river at Boston, Mass., have been declared to be obstructions to the navigation of the river owing to insufficient height above mean low water, insufficient width of spans, narrow draw openings and faulty construction. The Secretary of War has notified the city to so alter the bridges as to render navigation easy and unobstructed; these alterations to be completed by Jan. 1, 1891. The cost of the work is estimated at about $2,500,000.

——THE CHICAGO RAILWAY VIADUCTS, that were so vigorously started a year ago for the better protection of street crossings, seem to have come to a halt as far as new construction is concerned. The Illinois Supreme Court decided that abutting property holders could recover damages by reason of a change in street grades. The city acknowledged that it would have to satisfy the claims, but expected to get the money back from the railroad companies. But the railroad companies won't pay and the City Comptroller thinks there is no chance for a settlement for years to come.

——THE POUGHKEEPSIE BRIDGE was crossed by a train from the East end on Dec. 29, the connection with the N. Y. & Mass R. R. having been made that day. The presidents, chief engineers and contractors of the several Companies took part in the informal opening. As soon as the western connections are finished, the structure will be opened to traffic.

——THE ARTHUR KILL BRIDGE, of Staten Island, must defend itself at law against the charge of obstructing the work of the Pennsylvania Railroad Co. as a common carrier. Judge WALLACE, of the U. S. Supreme Court, has decided that the Pennsylvania Railroad Co. can recover damages, if its charges are proven.

——THE BROOKLYN BRIDGE TRUSTEES will put into operation immediately an automatic signal at both stations, by which a train coming up to the platform will cause a red disk to spring out. This will remain in full view of all approaching trains until the train at the platform has been drawn away.

——BRIDGE ACCIDENTS are reported as follows: At Newark, N. J., COFRODE & SAYLOR are rebuilding the several bridges that carry the Newark & New York Railway over the streets, and at Charles St. a temporary structure had been erected to support a travelling derrick. On Dec. 31, a train struck a projecting timber and in such a way that the whole trestle was pushed to the ground. Five men, who had been busy upon it, were thrown to the ground and four of them were severely injured.——The swing bridge over the canal at Benton Harbor, Mich., broke down recently under a team with a load of lumber. No one was hurt.

——THE VICTORIA BRIDGE suffered from a derailment accident Dec. 8 which illustrated for the thousandth time the impropriety of leaving bridge approaches unprotected by rerailing guards, and the danger of unnecessarily using both a front and rear engine. An empty car on a mixed train, the fifth from the engine in a train of 7, mounted the track at the west switch frog just before entering the bridge. There was, for some reason, a pushing engine behind. None of the train crew felt any pull, but the watchman at the portal noticed the derailment, and set a flash-light signal ahead within the tube which caused the engineer to quickly (too quickly) bring his train to a stand-still. The derailed car was then crushed as between the upper and the nether millstone, back across the track about 200 ft. from the entrance end of the tube, and two following cars ran upon it and were badly broken, causing a block of 4½ hours. No harm worth speaking of was done to the bridge and the highly creditable fact was brought out that this was the first derailment of the kind in a period of 12 years; but it was quite unnecessary to have had this one had rerailing guards been in use at the ends of the bridge.

——THE MOST SERIOUS RAILWAY ACCIDENT of the week was a head collision Dec. 27 at Tip-Top, Col., between two freight trains on the Chicago, Rock Island & Pacific. The collision occurred in a cut on a curve. One man was killed and 4 injured, 2 of them fatally.——Another serious accident was the derailment of a passenger train, Dec. 28, at St. Joseph, La., on the Texas & Pacific. A plantation siding switch had been left open, but the engineer saw the danger and reversed his engine. The engine and baggage car left the track; the engine fell over on its side and the boiler burst. The engineer was killed. It is reported that the switch had been opened by train wreckers.

——LAND has been caving-in near Shenandoah, Pa., over a part of the abandoned workings of the Buck Mountain seam in the West Shenandoah colliery. The area of surface affected is 200 yds. running East and West, and 80 yds. running North and South. It made a breach under the west-bound track of the Lehigh Valley road, 40 ft. deep and 15 ft. in diameter. The Pennsylvania Railroad turn-table and round house sank about 12 ft., destroying the foundations. The Pennsylvania track that switches near the round house from the Lehigh Valley road, sank about 15 ft., and for a considerable distance it was left suspended. No further trouble is expected, and gangs of laborers are at work filling the cavities with rocks and dirt. Traffic on the Lehigh Valley Railroad was not interfered with, as the bed of the east-bound tracks was not damaged.

——THE BOARD OF ELECTRICAL CONTROL, of New York, reports to Governor HILL that 240,155 lin. ft. have been excavated for laying subways and that 2,287,880 ft. of single duct for telephone and telegraph service have been constructed in this city. The total capacity for wires is about 34,665 miles for telephone and telegraph, and 600 miles for electric light and power wires. They say that 4,453 miles of electrical conductors have been placed in the subways. The report complains of the escaping steam from the pipes of the Steam Heating Co. It also says that from 30 to 50 per cent. of existing poles and wires are "dead", and exist in violation of the rules of the Board, which have not been enforced by the proper authorities. The report says nothing of the degree of perfection of the subways as built.

——THE WESTINGHOUSE ELECTRIC LIGHT CO., of Pittsburg, has completed its contract of one year ago for lighting the Hoosac Tunnel. There are 1,200 large size incandescent lamps, run by 3 No. 1 Westinghouse alternating current dynamos. The lamps are arranged in sections of twenty 50-volt lamps; the lamps are 40 ft. apart, alternating on the two sides of the tunnel, thus bringing them really 20 ft. apart. The work is pronounced a success.

——THE PHILADELPHIA & READING R. R. TERMINAL scheme, for an elevated railway to 12th and Market Streets in Philadelphia, seems to be moving. But a report that arrangements had been made that, if approved by City Councils, would enable them to commence building at once is premature. The bone of contention has been the complete removal of the surface tracks and an appropriation by the city and the passenger railway companies for this purpose.

——THE MEIGS ELEVATED R. R. Ordinance passed the Chicago city council on Dec. 28. It provides for the construction of an elevated road on the Meigs plan along Lake St., Chicago. The whole road is to be finished in 2 years and 2 miles are to be built the first year, under a guarantee of $100,000 placed in the City Treasury. The city reserves the right to place along the tracks, telephone, telegraph, electric or police or alarm wires. It is expected that the Mayor will send the ordinance back to councils for some amendments.

——THE NEW YORK CENTRAL has submitted a proposition to the Buffalo Commissioners for carrying out the proposed terminal improvements by which it and other companies (when they agree by like instruments are to bear the cost of all work on land owned by the rail ways, and the railways and the city are each to bear half of the expenses for work, right of way, damages, etc., on ground exterior to the exterior lines of right of way. It remains to be seen what action will be had. Progress seems to be gradually made toward agreement.

——THE NEW MONTREAL STATION of the Canadia Pacific is completed. It was illustrated in our issue of March 3, 1888. Architecturally it is almost, if not quite, the finest on this Continent. The ladies' waiting-room is 26 x 40 ft., 15 ft. high, with handsome fire-places, mantel-pieces, etc. The main waiting-room is 70 ft. square and 28 ft. high, very handsomely designed and finished, the while building reflecting the greatest credit on the architect, BRUCE PRICE, of New York.

——THE VERTICAL PLANE FREIGHT-CAR COUPLER, recommended by the Master Carbuilders' Association, was recently tested at Albany in the presence of many interested railroad men. According to press reports, the trial was a success in every particular and it was pronounced the best of its type yet put on the market. The coupler worked under very severe tests; cars in line 10 ft. apart coupled when sent bumping together by an engine at speed; it coupled with other couplers of a similar type; the same result followed when the engine backed on to it at twenty miles per hour, and its strength was further demonstrated by connecting the couplers by a heavy steel chain and starting the engine forward until the chain broke.

——LEAGUE ISLAND IMPROVEMENTS, recommended by the commission appointed to consider the improvement of the Navy yard amount to $4,000,000. There are now in hand $550,000 for the building of a dry-dock and $75,000 for a sea-wall.

——A SUBMARINE CABLE is to be laid from Bermuda to Halifax. The British Government has agreed to pay $60,000 per annum subsidy to the company. The distance is about 750 nautical miles, and work is to be commenced in the Spring.

——IMMIGRATION is falling off. It was for various past periods.

	1888	1887
Month of November	25,419	32,198
5 mos, ending Nov. 30.	182,375	204,195
11 mos. " "	498,583	487,646

The greatest falling off is from Germany and Austria. Italy also is decreasing.

——THE EDGE MOOR BRIDGE WORKS is the name of a new corporation organized Nov. 1, 1888 to succeed the Edge Moor Iron Co. in that branch of the business which includes the building of iron and steel bridges, viaducts, elevated railways, piers, roofs, etc. etc. The President of the new company is HENRY G. MORSE, WM. SELLERS is Vice-President and WM. F. SELLERS, Secretary. The bridge manufacturing plant has been increased in the past year by the erection of a girder shop 455 ft. by 215 ft., fitted with new and improved machinery.

——IN THE PAST LAKE NAVIGATION SEASON, 48 vessels aggregating 17,000 tons were lost, being somewhat above the average, but less than in several other years. On the other hand, 59 boats, of about 100,000 tons burden, are to be built for next year's trade. Of these, 13 of 31,000 tons, will be built at Cleveland, 8 being of steel.

——HARNESSING THE RHINE is the purpose of a company now being organized at Basle, Switzerland. The capital wanted is $2,000,000, and with this it is proposed to build a canal 2½ miles long and thus make available a water-power of 3,5000 H. P. estimated. They would distribute this power by electrical transmission.

——THE DRAINAGE OF THE CITY OF MEXICO is being started in earnest by the successful floating of a 7 per cent. loan of $2,000,000 at par in London. A larger loan for $10,000,000 is being now negotiated at 5 per cent., as the first would simply commence the work, which includes the tunnel, canals, the reconstruction of the sewerage system of Mexico, and the introduction of high service water into the city.

——A PROJECTED RAILWAY IN BRITISH HONDURAS offers a chance for American capital and contractors, although it is most probable that it will be built and worked by English capital. Proposals are now being advertised for, in England, for the construction, equipment maintenance and working of a railway, on the land grant system, from the town of Belize to the western frontier of the colony, with a pier at Belize. The distance is about 90 miles, and the contractor will have to obtain a concession for the extension of the railway into the territory of Guatemala. The government of British Honduras will make a grant of 5,000 acres of land per mile of line, and will pay $300,000 in instalments. Proposals will be received until April, 1889.

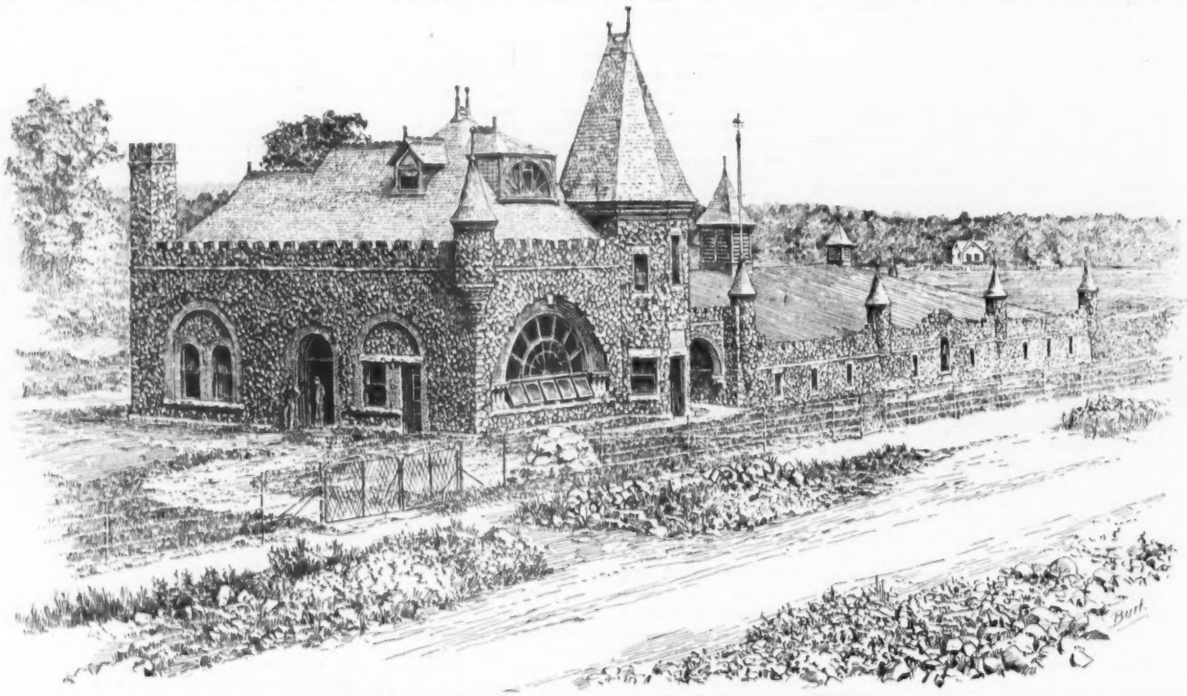
——A CONSOLIDATION of the railways in Wales will shortly be effected. There are twenty-four lines, with a total mileage of 540 and a capital of $14,000,000. There are no less than eighty directors, who all draw handsome salaries. The Taff Vale and two mineral lines are the only paying lines. The Chester & Holyhead is a portion of the great Northwestern system of England. A bridge is to be erected across the Dee for connection with Liverpool.

East Orange Sewage Disposal Works.

We begin our description of these works by presenting a view of the very handsome structure which has been erected to contain the disposal tanks, and sludge compressing plant of these interesting works, the first of their kind in this country, description and plans of which will appear next week. The drawing shows that even buildings for such unsavory purposes may be made attractive if there is the will to do so, and without any serious additional expense.

Locomotive Engine Resistance.

The following editorial, which we reprint in full from *The Engineer*, is discussed on our editorial page. We have been waiting for several weeks to find room for it, and for an accompanying editorial discussing the various points raised in it, but an unusual press of matter has prevented our doing so heretofore. It will be read, we are sure, with interest.



Sewage Disposal Works: East Orange, N. J., Sewerage System.
C. PH. BASSETT, Engineer.

LOCOMOTIVE ENGINE RESISTANCE.

In another page we reproduce a carefully written article on train and air resistance from our American contemporary, ENGINEERING NEWS. Like ourselves, our contemporary appears to be actuated by a desire to arrive at the truth, and not to achieve a barren dialectical success. A discussion can be carried on under such conditions certainly with pleasure, and we hope with profit. It will be seen that the subject divides itself under two heads, engine resistance proper and air resistance. It is a regrettable truth that it is almost impossible to make any statement concerning train resistance that cannot apparently be disproved by facts. A very considerable number of experiments and investigations have been made at various times in different countries, all carried out with care and skill. Instead, however, of these experiments enabling engineers to consolidate their views and confirm their knowledge, they are so far contradictory that everything almost remains a matter for conjecture. Evidence of this will be supplied as we proceed.

Our contemporary continues to maintain that at high speeds the engine resistances absorb as much as 50 to 60 per cent. of the whole power developed, and to prove this he cites certain experiments made by Mr. DUDLEY in the United States, and by M. DESPOINT and M. RICOUR in France, which, unquestionably, powerfully support his contention. Very little reference is made, however, to the cause of this great resistance. Mr. DUDLEY cites the case of an engine indicating 766-horse power at 51.43 miles per hour; of this no less than 426-horse power were required to propel the engine alone, while 340-horse power went through the draw-bar to the train. The total resistance of the engine was 3,106 lbs. It must not be assumed that this resistance was due to back pressure on the pistons; that is already accounted for in the diagram. That is to say, the indicated horse-power was reduced by the back pressure. The horse-power is of course calculated in the usual way, on the basis of the average total pressure on the pistons got from the indicator cards. To what, then, are we to attribute the excessive resistance of this engine? Let us take it for granted, for the sake of argument, that our contemporary is right, and that it is mainly due to head resistance. We cannot of course do more than guess at the cross-sectional area of the engine; but this, allowing for a large cab, could not well be more than 80 sq. ft. But the pressure of wind moving at 50 miles an hour is less than 13 lbs. per square foot; consequently the maximum head resistance that could be caused by still air would be, in the case we are considering, $13 \times 80 = 1{,}040$ lbs. leaving 2,066 lbs. to be accounted for. It will be admitted, we think, that we have here exaggerated the wind resistance, especially if there is any truth in our contemporary's contention that sharpness of form has an influence, because the locomotive resembles far more a blunt wedge, with the cow-catcher and head lamp at the point and the cab front at the butt end, than a simple flat plane. But assuming that our figures are accurate as they stand, it is clear that the cause of an enormous resistance remains to be found. In 1867 a series of most important experiments was made in France by MM. VUILLEMIN, GUÉBHARD, and DIEUDONNÉ. They found that the total resistance of a four-coupled locomotive at 37.2 miles per hour was 12.76 lbs. per ton. Unfortunately this was the highest speed they dealt with. It is very difficult to formulate any law concerning the rate of augmentation of engine resistance from their figures, but there is some reason to think that at 50 miles per hour the resistance would be about 17 lbs. per ton. It was also found that four coupled and single engines would run down inclines of one in 200 at "normal speed". Unfortunately what the normal speed was we do not know precisely, but it may be taken at about 35 miles per hour. This represents a resistance of about 11.2 lbs. per ton. But Mr. DUDLEY's experiments give a total engine resistance of 49.85 lbs. per ton. The calculation based on the figures we have taken stands thus:—Resistance due to air, 16.5 lbs. per ton; other resistance, 17 lbs. per ton; total resistance, 33.5 lbs. per ton, which is a long way below Mr. DUDLEY's figure. Furthermore, it will be seen that Mr. WELLINGTON in his treatise only rates head-wind resistance, and oscillation, and concussion, together at 4 lb. to 8 lb. per ton. It is quite clear, we think, that the results quoted by our contemporary are quite inconsistent with those obtained by the French engineers.

But taking Mr. DUDLEY's figures as accurate, on what was the enormous proportion of horse-power expended? Not certainly in overcoming wind pressure, not in overcoming the resistance in the blast pipe, not in internal friction of the engine; that must be a small quantity. It has, for example, been shown by experiment on the Metropolitan Railway that with a pressure of only 6 lbs. in the boiler, the driving wheels being jacked up out of contact with the rails, the wheels can be made to revolve rapidly, and in one case an engine has been made to turn round with only 4 lbs. pressure.

Experiment has shown with other engines that internal resistance is tolerably constant, and fairly independent of the load. In seems to be clear, therefore, that only one source of resistance remains unexplained, and that is the road. On a perfectly smooth, stiff, and level rail the rolling friction is extremely small, and it is quite possible our contemporary is approximately right in asserting that the resistance at the tail end of a train does not greatly augment with the speed. Let us consider, however, what the locomotive has to do. As the very best road is yielding, the engine has to continuously run up hill. It has to push down and consolidate the road for the vehicles following it, and it has been specially claimed for the bogie by American engineers that it is a "track setter." It will be readily understood that the rail has to be bent a little and pushed down into the sleeper, and the sleeper has to be pushed down into the ballast, and all this represents work. The train has not this work to do, especially at high speeds, to anything like the same extent, because the rail has not time to spring up again after the passage of the engine. There is a certain analogy here between the action of a ship and a train. The bows of the ship have to push the water out of the way. The middle body follows without offering any resistance save skin friction. The locomotive does that vertically—in a sense—which a ship does horizontally in another sense, and the train fills the part of the middle body of the ship; and it is not impossible that as the rail rises behind the last vehicle, that may be said to be always running down, just as the locomotive is always running up hill, and its resistance will be proportionately diminished.

This explanation must be taken for what it is worth, but we are unable to see where it fails. If it is true, then the difference between the total power exerted by the engine and that transmitted to the train will depend on the quality in respect to stiffness of the road, and this will explain why it is that vertical stiffness or resistance to deflection is a characteristic so highly prized by English railway engineers. It also follows that in all probability the road on which Mr. DUDLEY's experiments were made was a weak one, and consequently it must not be assumed that because the engine, and, we assume, the tender—for we cannot think that the engine alone weighed 63 tons—used up 55.61 per cent. of the total indicated horse-power, that anything like this proportion must of necessity always be lost when the speed reaches 50 miles an hour. That a large proportion is expended we do not for a moment dispute, but we contend that it would be rash to draw too wide generalization from Mr. DUDLEY's figures. Concerning what our contemporary has written of Mr. STROUDLEY's paper, we may say that he seems to have misunderstood Mr. STROUDLEY, who speaks of the gross weight moved, including the engine.

Turning now to our contemporary's arguments in favor of influence of form as affecting the resistance of an engine, we have already shown that the most exagge-

rated estimate of wind resistance leaves it a small factor; but putting this on one side, we would call attention to the circumstance that our contemporary adduces no shadow of proof that it can have an effect. On the other hand, the accuracy of the figures given by LARDNER are indisputable. Our contemporary does not dispute them, but maintains that the deductions drawn by LARDNER are unsound. We fail to see that the reasoning of our contemporary, based on loaded and unloaded box cars, bears on the matter at all. If it proves anything, it proves that the box car can pass through the air without any resistance; but this is obviously not what the ENGINEERING NEWS wants to convey.

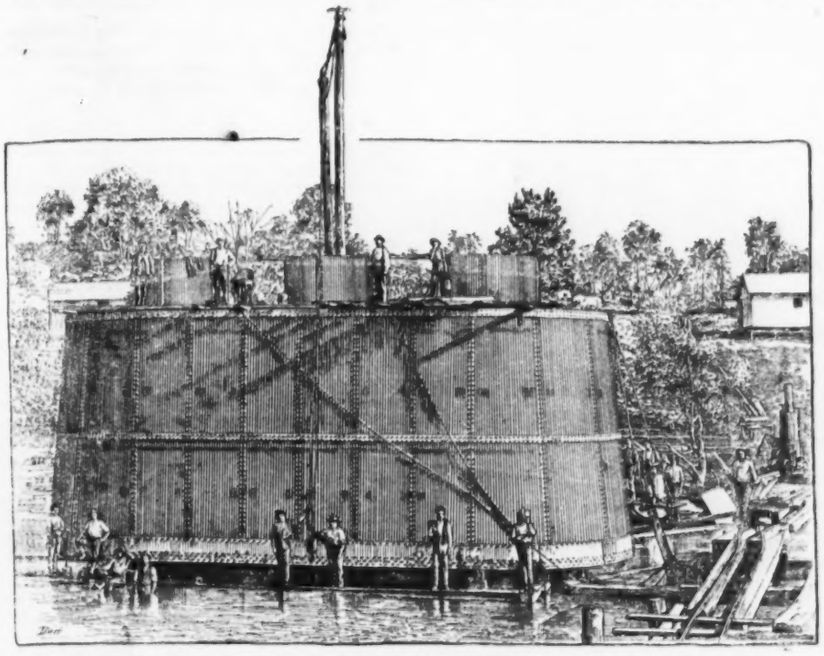


Fig. 1.—Hawkesbury Bridge. Cutting-shoe of Caisson on the Launching Ways.

As to the influence of form, we have not, as our contemporary says, asserted that "form is of no importance." What we have said is that "if the resistance is caused by pressure, then the form of the body driven through the air can have no effect." If, for example, it could be shown that the resistance was due to some form of impact, no doubt an inclined surface mig t offer a greatly reduced resistance. It remains to be seen if there is anything analogous to impact in the case. Having used the words: "Unless the pressure per square foot is in some way reduced below 35 lbs., whether this is or is not possible, we do not know; we do know that there are very good reasons why it should not be reduced"; our contemporary wants to know what these reasons are; and we are happy to state on what they are based, without going into minute details and resorting to diagrams to illustrate our meaning. Fore and aft rigged ships take the wind on their sails at an angle; this angle tends to heel them over, and the inclining effect seems to be that which is proper to the sine of the angle made by the sail —that is to say, to the base of a wedge, one of whose sides is the sail, and the other side is parallel to the direction of the wind. If the sail should act the part of a cut-water, so to speak, then the heeling power would be reduced. But our contemporary will find that in calculating sail areas the prow action which he claims to exist is never allowed for. He cites the cup of an anemometer; but has he ever asked himself why cups are used instead of solid hemispheres?

Our contemporary has a very simple and straightforward way of dealing with BEAUFOY'S statements. Fortunately, the experiment is so simple that if he can get access to any pond he can try the experiment for himself with a board and a spring balance. When he has done this it will be quite time enough to dispute BEAUFOY'S accuracy. The fact that a triangle will tow more easily with one side first instead of one angle is readily explained. A ship is continually propelled forward by the water falling in behind and pushing on her inclined stern lines, just as a wind-mill vane is driven round by the air pressing on it at an angle; and FROUD has demonstrated that so perfect is this action that to a well-made hull there is absolutely no resistance offered by water save that due to skin friction and the formation of eddies. If the stern of a ship was, so to speak, sawn off square, the water falling in at the sides would exert no driving action on the hull. It would expend its energy in the production of wasteful eddies under the stern. This is precisely what occurs when a triangular raft is towed angle first.

We venture to hope that our contemporary can bring forward additional facts from American experience. It is highly desirable that data of the kind to which we refer should be rendered complete by a statement of the precise area offered to the air by the engine, and by minute particulars of the construction and condition of the road. If we are right, the largest part of the power wasted is expended in consolidating the track. It will be seen that we have said very little concerning train resistance, confining our attention to engine resistance, and consequently, that we have not dealt with the question raised by our contemporary in his last paragraph, save incidentally.

The Hawkesbury Bridge.

In our issue of Feb., 1886, we gave a map of the site, the chart of soundings, and a general description of this important structure now nearly completed. At the risk of some repetition we will again give the general dimensions of the bridge and some points connected with its early history.

In Nov., 1884, a circular was sent out by the Government of New South Wales asking bridge builders throughout the world to send to the Government agent in London detail plans and tenders for a double-track steel railway bridge across the Hawkesbury river, a tidal estuary about 30 miles north of Sydney. The bridge itself was to be about 3,000 ft. long; but the foundations presented the difficulty. Soundings taken showed that some of the piers at least would apparently have to be founded 160 ft. below low water, and as the level of the rails was to be 42 ft. above low water, the total estimated height of pier was about 200 ft.

In 1885, Sir SAUL SAMUEL, on the part of the Government of New South Wales, named the following engineers as a board to examine and report upon plans submitted; i. e. Sir JOHN HAWKSHAW, Col. DOUGLAS GALTON and W. W. EVANS. By June, 1885, fourteen designs had been laid before this board; three American (excluding one design for an iron bridge), nine English plans and one French and one Australian design. The American bridges were all pin connected and the foreign designs all riveted lattice. The prices named averaged $1,464,720 for the 3 American plans, and $2,283,520 for the 9 English plans; with a minimum price of $1 364,000 (American) and a maximum of $3,413,590 for the Australian design, a figure very nearly approached by the French bidder with $3,329,100. Some of the foundation plans were absurd, when the nature of the material, the depth to be sunk and the presence of nearly 50 ft. of salt water in the river were considered. Though the tenders came from some of the most reputable bridge building firms in the world, the variety in spans and pier types proved either that the problem had not been properly considered in all its bearings or that the doctors in such cases differ widely as to the means towards a single end; a difference not at all in accordance with the popular acceptation of engineering as an exact science.

On Jan., 27, 1886, a cablegram from New South Wales announced that the tender of the Union Bridge Co., of New York, had been accepted for $1,589,220, the highest of the three American bids. According to the report of the London board of engineers, recommending this award, the plan of this company for the piers was the most engineering-like of any presented and promised the greatest measure of success, and upon this feature mainly the award was based. The plan of the Union Bridge Co. was for a double-track steel railway bridge 2806 ft. long between end-pins, divided into 5 spans of 416 ft. each between pier centers and 2 spans of 408 ft. each. The piers

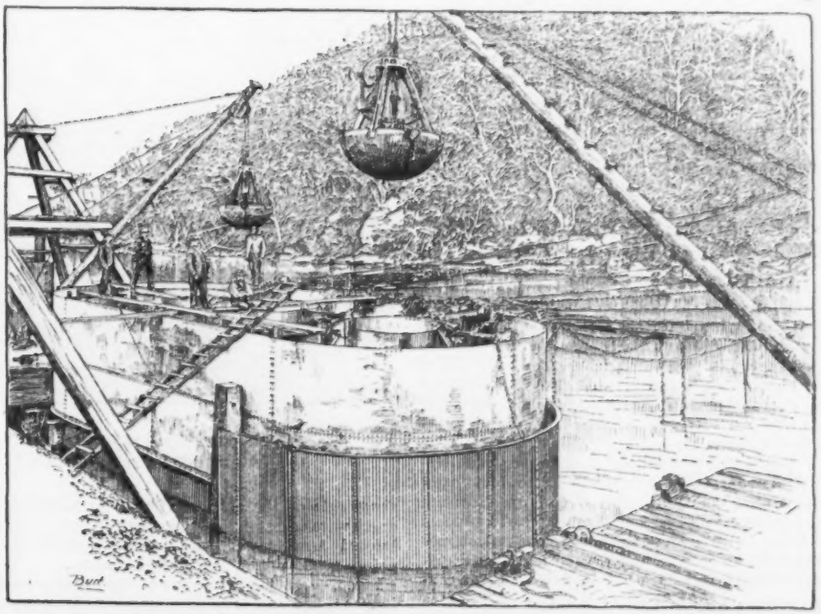


Fig. 2.—Hawkesbury Bridge. Caisson No. 6 in Process of Sinking; showing Excavator, and Shore Chains for Maintaining Vertical Position.

(see page 100, ENG. NEWS, 1886) were to be cut-stone masonry from low-water to the bridge-seat, and they were founded on a single iron caisson for each, 48 ft. long and 20 ft. wide with rounded ends and

vertical sides. Each caisson was provided with 3 dredging wells, each 8 ft. in diameter, with the concrete pockets surrounding these wells strongly braced between the wells and the shell. The cutting shoe of the caisson was 20 ft. high with an outward flare of 2 ft. all around in this height.

The sinking of these caissons was sub-let to the firm of ANDERSON & BARR, of New York, and these energetic men at once went to work to such good purpose that on Nov. 17, 1886, the first caisson was launched and towed into position for Pier No. 5; the last caisson of the six, for Pier No. 4, was launched on Nov. 27, 1887, or in just about one year after the actual sinking operations were commenced, and all work on the caissons was completed by May 15, 1888.

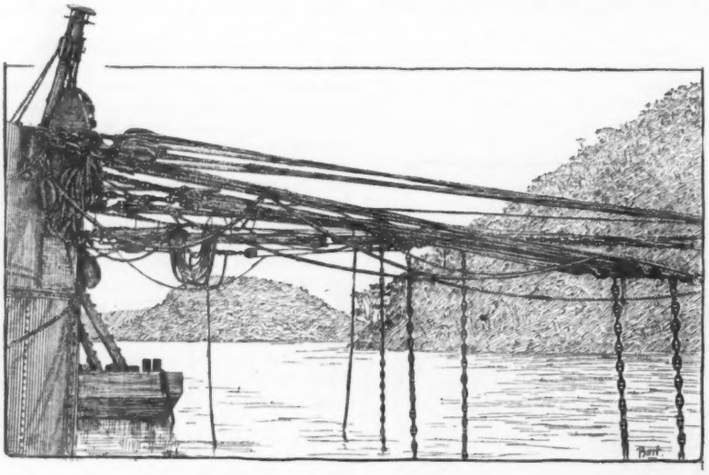


Fig. 3.—Hawkesbury Bridge. Chains and Falls for Hauling over Top of Caisson No. 6.

The difficulties met with and overcome in sinking these piers can be better appreciated from the following tabular statement of conditions actually met with:

Pier.	Depth, low water to river-bed.	Depth below river-bed.	Tot. height bottom to top of pier.*
No. 1	38 Ft.	55 ft. 8 in.	135 ft. 8 in.
No. 2	40 "	108 ft. 1 in.	190 ft. 1 in.
No. 3	43 "	96 ft.	181 ft.
No. 4	21 "	118 ft. 6 in.	181 ft. 6 in.
No. 5	19½ "	117 ft. 5 in.	178 ft. 11 in.
No. 6	47 "	108 ft. 0 in.	197 ft.

*The height from low water to top of pier is 42 ft. The difference between high and low water is about 5 ft.

The several views here presented are made from photographs kindly furnished us by Mr. JNO. F. ANDERSON, who was personally in charge of the work undertaken by his firm. Fig. 1 shows the lowermost section, or 20 ft. cutting-shoe, of one of the caissons under construction on the launching ways. At this stage of construction, the caisson was launched and towed to its position for sinking and anchored by six heavy ship's anchors, with 1½-in. mooring chains. Three or four wire ropes were also led to the shore for maintaining the vertical descent of the caisson; wire being selected for the reason that it would not stretch like hemp or manilla cordage.

When the caisson was anchored over the site of the pier, the wells and vertical sides were built up and the concreting of the sinking pockets carried on at a rate just sufficient to control the sinking of the caisson through the soft top material. As the varying displacement resulting from an average rise and fall of 5 ft. in the tide would be troublesome in maintaining the equilibrium of so large a caisson, this difficulty was overcome by pumping in and out sufficient water to preserve about a constant weight. Of course, as soon as the caisson had penetrated some distance into hard bottom this latter precaution ceased to be necessary; but this feature also required a class of riveting in the sheets that made it almost equal to boiler work, as the shell had to be watertight around the side and the wells.

Fig. 2 shows Caisson No. 6, which in process of sinking about 80 ft. below the river bed had gradually worked towards the shore and endways. It was, of course, essential to check this movement and this figure, together with Fig. 3, shows some of the expedients used by Mr. ANDERSON. To pull the top of the caisson towards the shore and thus give an outward tendency to the bottom in sinking, four large iron sheaves were put in place, two on the caisson and two on shore, and through these a wire rope 1¼-in. in diameter was run with strong luff-tackles attached to either end of the cable and the hauling parts of these falls led to winding engines stationed on the barges. Three chain cables, of 1½-in. round iron, studded, were also used, as shown in Fig. 3, where the vertical parts are simply the loose ends of chains hanging down in the water. To further secure an outward push on the caisson and to obtain a better fulcrum for the top inward pull, some thousands of tons of rock were dumped on the shore side of the caisson. These combined appliances were successful to the extent of checking the inward tendency of the toe and practically regained the lost position of the pier center.

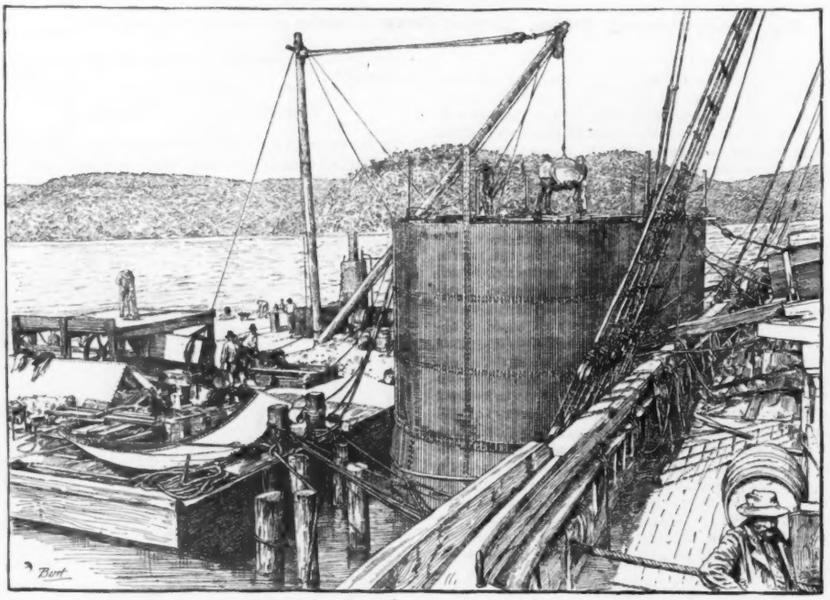


Fig. 4.—Hawkesbury Bridge. Sinking Caisson No. 5. Concrete Barge and Store Ship Alongside; the Latter also Used as Quarters for the Workmen.

Fig. 4, shows the concreting of one of the caissons just as it had started on its downward course, about 5 or 6 ft. of the inclined cutting-edge being still above the water, as shown. To steady the caisson in its first sink, guide piles were used, and it was also supported by the sides of the ship, which latter was also used as a storage for the cement, headquarters for the workmen and for carrying and operating some of the hoisting plant. The barges alongside carried the concrete-mixer and the dredging plant. The total quantity of concrete used in sinking and filling these caissons was 26,539 cu. yds.

The caissons were dredged down to hard bottom by the appliance shown in Fig. 2. This excavator, weighing about 3 tons, is the essential feature in the dredging system of Messrs. Anderson & Barr, and was previously successfully used by them in sinking the piers of the Atchafalaya, Providence and other bridges; hence their undertaking at Hawkesbury was not in the form of an experiment, difficult as it seemed to the majority of the bidders on that work.

As the best method of sinking piers by dredging through a great depth of material has been a subject of some discussion lately, the experience of Mr. ANDERSON in this extreme case is of especial interest. As to the question of inclined vs. vertical outer sides to the cutting-edge, his practice has led him to the conclusion that if the material is sand or silt, easily running, it really makes little difference, as the material closes in around the caisson and follows the excavation closely. But where the soil is clay or any other tenacious material that will more or less readily, maintain itself, or if the bottom is of unequal density, the inclination of the outer sides at the bottom presents a source of danger, and he much prefers a vertical cutting-shoe. The reasons given for this preference are as follows:—If it is essential to increase the bearing surface at the bottom of the caisson to an area which is not required in the upper portion, this end can be secured by a vertical cutting-shoe of considerable height with a step or steps into the smaller diameter. This is quite as efficient to secure the end in view as a long incline on the cutting-shoe and has decided advantages. In the denser material, the vertical sides leave the ground undisturbed for some height close to the skin of the caisson, and a vertical guide is secured which would be entirely wanting in the case of an inclined shoe. This guide is valuable in cases where the soil may differ in density under the shoe; and particularly so if the excavation has been carried too far below the bottom of the shoe. With an inclined shoe and a slip of soil into the dredging-well from one side more than the other, long experience in deep dredging has taught Mr. ANDERSON that there is a decidedly greater tendency to a horizontal movement than with a vertical shoe. The former has a flare to direct this sidewise motion in the first place, and nothing but a certain amount of disturbed material above the shoe to resist this tendency. At the Hawkesbury bridge both inclined and vertical shoes were tried; and the experience was that the caissons having the incline were those that gave all the trouble encountered in the foundation work. The

last three piers sunk had a vertical shoe and gave no trouble.

Fig. 5, in our illustrations, shows span No. 7 being towed to the bridge site, and the same span in position between the bridge seats. Owing to the great depth of water and mud, the usual erecting falseworks were impracticable. For this reason mainly, the Union Bridge Company erected its superstructure on pontoons supported on piles at the shores of the estuary. The pontoon used was 335 ft. long, 61 ft. wide and 10 ft. deep, divided into water-tight compartments. On a system of falseworks erected on this pontoon the superstructure was put together, complete, with sufficient overhang at the ends to bring the truss over the bridge-seats. This work was successfully carried out with only such troublesome features as were incident to the distance of the abutment bridge-seat from the river-bank and some difficulty in bringing the pontoons into positions. As we have reason to believe that a very full paper will be presented to the American Society of Civil Engineers on this most interesting and important piece of work, any further description will be deferred until then.

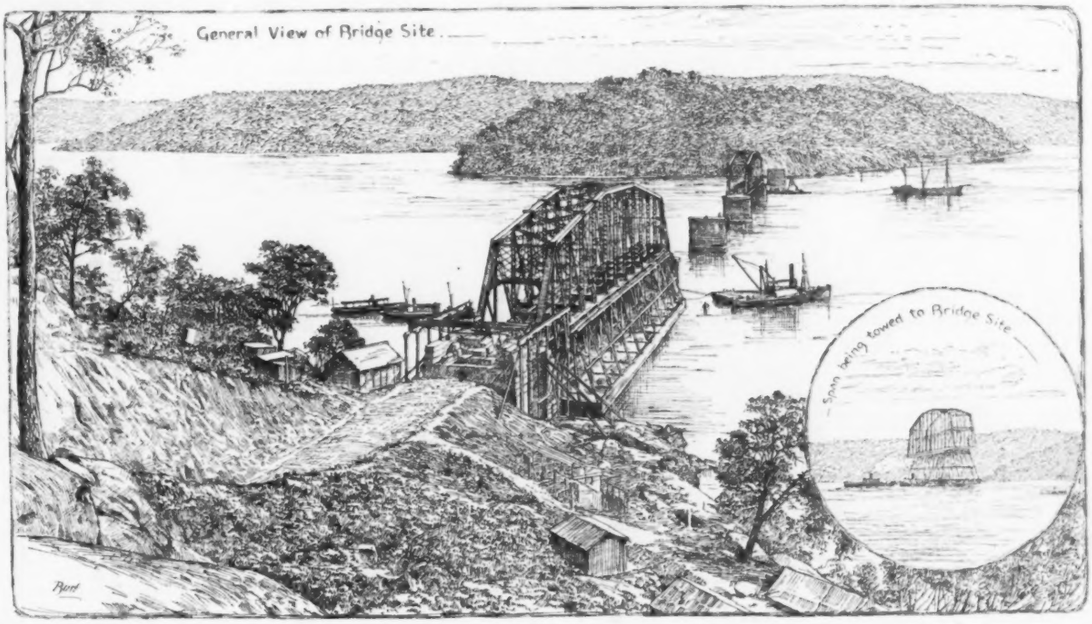


Fig. 5.—Hawkesbury Bridge. Span No. 7 being Landed on Piers from Pontoon, and the Same Span being Towed into Position. Span No. 4 already in Position on Piers.

THE great pyramid of Cheops is built upon a plateau 137 ft. above the highest rise of the Nile water. The masonry consisted originally of 89,028,000 cu ft., and still amounts to 82,111,000 cu. ft., after the wholesale destruction of the casing for use in building Cairo. The total weight of the structure is estimated at 6,316,000 tons and must have cost some 30 or 40 million dollars to build.

——THE CONSTRUCTION OF A VERY HIGH DAM 200 FT. or more, across the Rio Grande above Fort Seldon, to store water for irrigation, is actively urged. Above Fort Seldon the river is little more than a cañon for 120 miles.

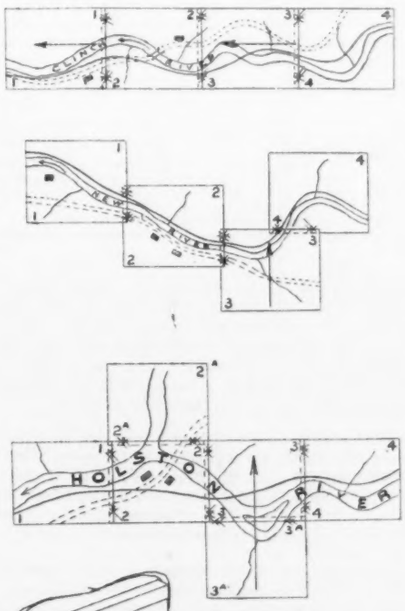
Maps for Railway Surveys*.

The preliminary and location lines of a railway survey are usually plotted on a continuous roll of drawing paper, the length of the latter depending on the scale used and the length of the line run. The less frequently used method of plotting the lines on separate sheets possesses many advantages over the continuous roll one.

For this purpose sheets measuring 19 by 24-ins., technically known as *Royal*, are best. As to the kind of paper that bearing the imprint "Weston's Linen Record" gives excellent results. This paper has a smooth finish and can be readily obtained of the size mentioned.

For plotting, the scale of 200 ft. per in. is preferable, according to which each sheet will contain about one mile counting the long way of the sheet, so that the number of sheets will correspond very closely with the length of the survey expressed in miles, excepting cases where the surveyed line is very crooked and devious.

In plotting the line, it is not necessary to place on the drawing table the whole number of sheets required; 3 or 4 will be a sufficient number at a time. They should be placed in a row, the top and bottom of the sheets being even, and at the same time letting the edges overlap ½-in. After the sheets are placed down and securely fastened with thumb tacks, connect them at their overlapping edges by means of crosses drawn with red ink;



Arrangement of Maps for Railway Surveys, and Portfolio for Carrying Maps.

this for the purpose of noting any change in their position while working on them, and also that the sheets may be accurately fitted together again after they have been taken up.

In order to properly identify the different sheets, mark them with appropriate numbers placed in the upper right hand and also in the lower left hand corner.

Make the meridian (north and south line) parallel with one of the edges of the paper, depending on the direction of the survey. When the line of the survey is either east or west, the meridian should be placed parallel with either the top or bottom of the sheets. The two middle figures of the cut show the first case, and the upper figure the second.

When the direction of the survey is not with the cardinal points it is apparent (with the meridian placed parallel to the edges of the sheets) that the plotted line will cross the sheets diagonally, and if they are placed together in a straight line, it is obvious that the line will run off the paper entirely. One way to obviate this is to step the sheets at their junctures either up or down, as the exigency may require, instead of placing them side by side in a straight line.

It is not to be advised though that a sheet be stepped up or down more than one-half its width, as there is danger from too small a lap that they may not be able to be placed together again (subsequently after their taking up) in their exact original position.

Another method would be to determine the general direction of the line, and then placing the sheets in a row, plot the line as best suited. When the variation from an axis of the line to the right or left exceeds the width of a sheet, it would, of course, be necessary to place additional sheets above or below to cover the deficiency.

By this method the meridian would not be parallel to the edge of the paper, and for this reason I prefer the other plan of placing the sheets; for from an examination of the sheets, an idea is rapidly formed of the direction of the survey.

The principle involved is the same as the one by which large maps are drawn, and that is to have the north end always on top. Of course it is only possible to have the top of the sheets *north* only when the line runs east or west. When it runs north or south I would prefer to have the east at the top.

Another advantage of plotting on sheets over rolls of paper is that any particular portion of the line can be more readily examined, and tracings can also be more easily made of separate parts. They can also be filed away in drawers, remaining flat all the time, and need not be rolled, thus keeping their shape better.

When a continuous map is desired, one can be made by using tracing cloth, the rolling of which is not so objectionable as that of heavy drawing paper. These sheets are also very useful in the field when running in on the ground a projected or *paper* location. They are more readily handled than a roll map, especially in windy weather. For their proper transportation a portfolio made of wood is very convenient; its inside dimensions should be a little larger each way than that of the sheets. The wood, either white pine or poplar, should be perfectly seasoned, so as not to warp or crack in the sun.

The sides of the portfolio are made ¼ in. thick, the strip around the ends and bottom of ⅝ by 1 in. material. These pieces fitted together form an oblong box, having an inside width of 1 in. A lid made of tin and 2 ins. deep is used to cover the top. A strap is also attached to the sides for convenience of carrying. It will be seen that the box or portfolio answers admirably for a map board, and in it can be carried a couple of triangles, a paper pro-

*A Paper by Emile Low, C. E., read before Engineer's Club of Philadelphia Somewhat abridged.

ROCK EXCAVATION UNDER WATER.

Statement showing what work has been let at, in the various contracts made by the U. S. Engineer Department, from Nov. 1, 1878 to Oct., 31, 1888. Computed from Annual Reports of the Chief of Engineers.

Locality	Kind of rock.	Quantity †	Date	Depth of water.	Schedule of prices paid after public advertisement. $	Per yard, ton, etc.
Rock Island Rapids	Broken rock	3,500 cu. yds.	Jan. 1879	Not specified	3 75	Per cubic yard.
Hallet's Point Reef, N. Y	" "	2,500 tons	June "	To a depth of 26 ft. at low water	3 39	Per ton
Christiana river, Del	Solid rock	90 cu. yds.	Sept. "	" 13 "	28 50	Per cubic yard.
Wood's Holl, Mass	Bowlders	($9,000) *	" "	" 12 "	8 00	"
Providence river, R.I	Solid rock ledge	425 cu. yds.	" "	" 20 "	16 85	"
Delaware river	" "	3,000 "	" "	" 24 "	21 00	"
Upper Columbia river, Wash	" reef	1,100 "	" "	" 6 "	18 00	"
Clearwater river, Idaho Ty	" "	115 "	" "	Not specified	38 00	"
Upper Willamette river, Ore	" "	500 "	Oct. "	2 ft. below low water	8 00	"
Waddington Harbor, N. Y	Sandstone rock	1,000 "	Jan. 1880	To a depth of 8 ft. at low water	5 00	"
Detroit river, Mich	Ledge rock solid	($50,000) *	Feb. "	" 20 "	6 85	"
Merrimac river, Mass	" "	22½ cu. yds.	Aug. "	" 9 "	30 00	"
Back river, Me	" "	175 "	" "	" 12 "	35 00	"
Delaware river, Pa	Gneissoid "	2,150 "	" "	" 18 to 24 "	17 00	"
Portsmouth Harbor, N. H	Ledge rock	700 "	" "	" 20 "	27 90	"
Detroit river, Mich	" "	($50,000) *	" "	" 20 "	7 00	"
Upper Columbia river,	Reef "	100 cu. yds.	Nov. "	" 5½ "	25 00	"
Snake river, Mont	" "	650 "	" "	" 5½ "	17 00	"
St. Mary's Falls canal, Mich	" "	15,000 "	Oct. "	Water drained off	1 80	"
Clearwater river, Idaho	" "	100 "	" "	Shallow water	31 00	"
Oswego river, N. Y	Solid rock ledge	($50,000) *	May 1881	To a depth of 15 ft. at low water	7 00	"
Harbor at Bath, Me	Ledge rock solid	120 cu. yds.	June "	" 12 "	36 00	"
Harbor at Newburyport, Mass	" "	120 "	" "	" 9 "	27 50	"
" "	" "	63 "	" "	" 10 "	44 00	"
Echo Harbor, New Rochelle, N. Y	Gneiss reef rock	506 "	July "	" 9 "	15 80	"
Hudson river, N. Y	Reef rock solid	3,000 "	" "	" 12 "	11 00	"
Delaware river, Pa	Gneissoid "	($40,000) *	Aug. "	" 24 "	24 00	"
Detroit river, Mich	Solid ledge	($50,000) *	Aug. 1881	To a depth of 20 ft. at low water	7 00	Per cubic yard.
Upper Col. and Snake river	Basaltic reef	1,000 cu. yds.	Sept. "	" 5½ "	Av'ge 21 83	"
Columbia river near Cascades	Solid reef	($50,000) *	Aug. "	" 10 "	25 00	"
New Rochelle Harbor, N. Y	Gneiss solid	365 cu. yds.	July "	" 8 "	3 00	"
Portsmouth Harbor, N. H.	Solid ledge	600 "	April 1882	" 10 "	18 00	"
Detroit river, Mich	"	($60,000) *	Sept. "	" 20 "	7 50	"
Boston Harbor, Mass	"	50 cu. yds.	" "	" 9½ "	35 00	"
Newburyport Harbor, Mass	"	14 "	Oct. "	" 9½ "	110 00	"
" "	"	150 "	" "	" 9 "	35 00	"
Red river, La	Sandstone solid	6,000 "	" "	Not specified	3 45	"
Portsmouth Harbor, N. H	Solid ledge	700 "	" "	To a depth of 20 ft. at low water	34 50	"
Delaware river, Pa	"	($40,000) *	" "	Not specified	21 00	"
Clearwater river, Idaho	Reef solid	($5,000) *	Feb. 1883	To a depth of 4 ft. at low water	26 00	"
Woods Holl Harbor, Mass	Stones & bowlders	($52,000) *	April "	" 20 "	5 00	"
Mamaroneck Harbor, N. Y	Solid rock	617 cu. yds.	June "	" 7 "	21 00	"
Snake river, Wash. Ty	Basaltic reef	270 "	" "	" 5 "	12 00	"
Harbor at Georgetown, D. C	Gneiss solid	838 "	" "	" 20 "	17 00	"
Taunton river, Mass	Bowlders	($5,000) *	July "	" 11½ "	7 70	"
Detroit river, Mich	Solid ledge	($200,000) *	Aug. 1884	" 20 "	5 40	"
Portsmouth Harbor N. H	"	800 cu. yds.	Sept. "	" 20 "	22 00	"
Newburyport Harbor, Mass	"	52 "	" "	" 9 "	26 00	"
Cocheco river, N. H	"	1,506 "	" "	" 5 "	10 00	"
Eastport Harbor, Me	"	104 "	" "	" 12 "	24 90	"
Snake river, Idaho	Basaltic solid	90 "	" "	" 5 "	18 00	"
Snake river, Ore. and Wash. Ty	"	530 "	Oct. "	" 5 "	Av'ge 22 00	"
Harbor at Georgetown, D. C	Granitic solid	422 "	Nov. "	" 20 "	17 50	"
Taunton river, Mass	Solid ledge	366 "	" "	To a depth of 12 ft. at m.h.water	21 75	"
Harbor at Cedar Keys, Fla	Limestone	700 "	Dec. "	To a depth of 11 ft. at low water	6 50	"
Detroit river, Mich	Ledge, solid	($37,500) *	Oct. 1886	" 20 "	6 00	"
Lake Champlain, N. Y	Reef, solid	600 cu. yds.	" "	" 12 "	11 60	"
Hingham Harbor, Mass	Conglomerate	150 "	" "	" 10 "	27 00	"
Scituate Harbor, Mass	Solid rock	50 "	" "	" 5 "	8 50	"
Cocheco river, N. H	Ledge, solid	738 "	Nov. "	" 5 "	9 50	"
Portsmouth Harbor, N. H	Ledge, solid	632 "	" "	" 20 "	18 97	"
Ohio river at Grand Chain	Limestone	($35,000) *	Dec. "	" 6 "	4 85	Per ton
Ashtabula Harbor, Ohio	Ledge, solid	6,500 cu. yds.	Jan. 1887	" 18 "	2 00	Per cu. yd.
James river, Va	Granitic	250 "	Feb. "	" 22 "	8 00	"
Penobscot river, Me	Conglomerate	($15,000) *	May "	" 11 "	10 00	"
Harbor of Tampa, Fla	Limestone	1,500 cu. yds.	" "	" 9 "	5 90	"
Saco river, Me	Ledge, solid	214 "	July "	" 6 "	10 25	"
Mouth of Licking river	Limestone	($18,000) *	" "	Not specified.	13 00	"
Moose-a-bec Bar, Me	Ledge, solid	136½ cu. yds.	Aug. "	To a depth of 15 ft. at low water	16 20	"
Gloucester Harbor, Mass	"	150 "	Sept. "	" 14 "	14 75	"
Harlem river, N. Y	Dolomite	140,000 "	Dec. "	(Above the plane of low water	93	"
				) Below the " "	1 13	"
Boston Harbor, Mass	Ledge, solid	300 "	June 1888	To a depth of 23½ ft. at low water	22 00	"
James river, Va	Granitic	($25,000) *	Oct. "	" 22 "	6 33⅓	"
Detroit river, Mich	Ledge, solid	($130,500) *	" "	" 20 "	4 43	"

† Approximate. * Amount appropriated for this work.

tractor, etc. If a pocket box of instruments is also carried along, these will be sufficient drawing paraphernalia, to be used in the field as the occasion may require, and this is of frequent occurrence in running in a paper location.

Rock Excavation under Water.

By the courtesy of the Chief of Engineers of the United States Engineer Corps we are enabled to present to our readers the above very interesting and complete record of the cost of practically all the rock-work under water done on the Government work since 1878. Next week we shall attempt to abstract the substance of this interesting record, which however should be studied in full.

The Canadian Pacific Railway.

VIII.

THE PROVINCE OF MANITOBA.

The present confederated Government of the Dominion was formed July 1, 1867, after prolonged negotiations beginning in 1861. Its formation was the direct result of our war, and in the effort to counteract the then supposed disintegrating tendencies of our Constitution, centralizing tendencies prevailed which would hardly do so again if the organization were now in progress. The union was slow in forming, and at that time Manitoba was almost untenanted, except by a limited population of whites and half-breeds, who were anything but a promising foundation for a State, and anything but loyal to the proposed new order of things. A war finally brought them into subjection, and the original faction has now ceased to be a very important part of the population, although it is still a large part, as will appear from the statistics below.

Manitoba was admitted as a province in 1870, a few months after the acquisition of the great North-West Territory from the Hudson's Bay Co. British Columbia came in a year later, and Prince Edward's Island a year later, in 1872. Newfoundland still obstinately prefers to stay out in the cold.

The Canadian census is taken in the 1st year of each decade, like the English, and the condition of Manitoba at the time of its admission is indicated by the fact that in 1871 Winnipeg had only 241 inhabitants. In 1881 it had 7,985; in 1885, 19,574, and since then there has not been so much talk about its rapid growth. In fact, for a time it fell off, as a result of three disastrous crop years in succession, 1884-5-6. 1887 was a good year, however, and 1888 a still better one. The city now claims 25,000, and probably actually has something over 20,000. It is a handsome town, with many fine stone and brick buildings in it, and although real-estate is far cheaper than during the boom period, it is probably destined to become a large and fine city.

The census population of Manitoba, and the racial constituents thereof have been as follows:

	Manitoba	N. W. Territory
1871	18,995	
1881	65,954	56,446
1885		48,362 (20,170 Indians)
1886	108,640 (74.5 per cent.)	

Birth places of Manitobans, 1886.

	No.	Per cent.
Manitoba and territories	34,644	31.9
Other Can. Prov.	42,324	39.0
England	10,322	9.5
Scotland	5,962	5.5
Ireland	3,621	3.3
Russia and Poland	5,724	5.3
Iceland	1,908	1.8
United States	2,322	2.1
European countries	1,048	1.0
Chinese, etc., etc	655	0.6
Total	108,640	100.0

That Manitoba is not regarded by Americans as a very attractive place in comparison with their own adjacent territories, is indicated clearly by these figures, there being a mere handful of Americans in Manitoba, and those chiefly in the cities engaged in mercantile and manufacturing pursuits. That its recent development has been somewhat abnormal is indicated by the fact that between 1881 and 1886:

The agricultural class increased	9,317 or	68.6 p.cent
" commercial " "	1,980 "	147.8 "
" domestic " "	1,271 "	133.3 "
" industrial " "	1,260 "	59.5 "
" professional " "	1,222 "	192.1 "
" not classified " decreased	1,607 "	−37.2 "
" land occupied increased	1,780,888 acr's or	79.9 "

These statistics indicate a speculative rather than solid growth, in part, no doubt, superinduced by

the large expenditures for railway construction in that period. Again, during the same period, the inhabited houses increased from 12,102 to 22,180 or 83.2 per cent., while the uninhabited increased from 796 to 1,958 or 145.9 per cent., and the number being built had decreased from 1,136 to 545, or 52 per cent.

As compared with Dakota, the growth of population has been as follows:

	Manitoba.	Dakota.
1870	14,000	14,181
1880	—	135,177
1881	65,954	—
1886	108,640	520,000

In 1880, out of Dakota's very moderate population, there were 10,678 Canadians living in it, or 7.9 per cent. of the whole, against 2.1 per cent. of Americans in Manitoba. This was before the disastrous 3 years in succession of bad crops. Since then the absolute number of Canadians has greatly increased, but probably not the proportion. Considering how vastly larger a population there is to draw from on the south, these figures are highly significant. They indicate what becomes evident on examination, that there are great drawbacks to farming life in Manitoba. The wheat problem is said to be successfully solved. By plowing in the succeeding fall and sowing very early, when only an inch or two of frost is out of the ground, the crop has time to mature with ordinary good luck, and it may well be that in spite of the severe winter weather and danger of early frosts, the abounding fertility of the soils and other favoring circumstances noted two weeks ago (including especially the low comparative evaporation shown by the map in our last issue) will make the crop as secure as in regions to the south or more so. Potatoes and other root crops also do exceptionally well. But corn cannot be raised in Manitoba, nor any of the common fruits, nor can many minor crops be raised to advantage; so that the region is practically restricted to one kind of crop, wheat, as a money crop. Manufacturing is also practically out of the question on any considerable scale. The market is not large enough at home, and it is quite out of the question to manufacture for export. Consequently, the Manitobans are under these disadvantages as compared with their neighbors to the South: They pay higher prices for a large part of what they consume (which chiefly comes from the States) by the amount of the Canadian tariff *plus* a longer average haul. On what they import from Eastern Canada they have a heavy transportation charge and have to put up for the most part with inferior quality, most of the farm machinery and plant coming from the States because of better quality in spite of the high tariff. On the other hand they have no home market even for their wheat. It may hereafter be ground in the province; there is a wonderful opportunity for a second Minneapolis at Rat Portage, but as yet it is not; and they have to export almost everything on which they get money to Europe, with of course a materially heavier average transportation charge on their entire products than in the States to the south, which have largely a home market. Hence the Manitoban has to take less for what he sells and pay more for what he buys.

The conclusion to which the dispassionate observer seems led is that if Manitoba were a part of the United States it would settle up quite rapidly by natural overflow from the South, but that Manitoba now suffers from a commercial isolation, far more than any other part of Canada, and is not likely to fill up with population very rapidly (measured by American standards) for some years to come, although the absolute increase will be considerable. The total area of the province is about 123,200 sq. miles, extending down to Lake Superior, but nearly two-thirds of this, the easterly and northerly portion, is worthless agriculturally or occupied by lakes, leaving an area somewhat larger than the State of Indiana, or about two thirds that of Iowa, of really fine land; and this land is fine indeed. It is mostly dead flat prairie, and as our map in last week's issue shows, is fairly well supplied with railways, but with little tendency to increase.

—A GRAVITY RAILROAD is proposed for Reading, Pa. It would ascend Mt. Penn., a pleasure resort in the neighborhood, and over one-third of the $100,000 required to build it is said to be subscribed.

Improved Water Supply for Newark, N. J.

An improved water supply for Newark, N. J., has been the subject of investigation by a committee of the Councils of that city. This committee made the following report, in substance, last week: It has received three propositions. One from Mr. J. R. BARTLETT and associates, who offer to deliver from the Passaic water-shed a maximum quantity of 50,000,000 galls. of pure water daily for $40 per million gallons. A previous offer by Mr. BARTLETT of $33.50 per million gallon is withdrawn, in the light of re-surveys and new reports. Mr. BARTLETT says that the quantity mentioned above, while in accordance with the committee's request, is excessive, and 30 years will elapse before Newark requires much more than half of that supply; 25,000,000 or 30,000,000 galls. could be furnished in 3 years.

The second proposition was from the Lehigh Valley Railroad Co. which possesses ample water privileges and has legislative authority to make such changes in the Morris Canal as may be required to adapt it to a water supply. The company prefers to dispose of these water rights absolutely; but suggests the following plan: The Lehigh Valley Railroad Co. will place its waters at the disposal of a properly organized water company, with a capital stock of say $3,000,000, and such company shall enter into a contract to supply Newark with all the water the city may require for its own exclusive use, delivered into Belleville reservoir, during a term of 25 years, at the rate of $39 per million galls. up to a consumption of 20,000,000 galls. daily. The rate on the whole quantity to be reduced at the rate of 50 cts. per million gallons for every million gallons taken in excess of 20,000,000 galls. daily, until the price shall have been lowered to $36 per million gallons, and to remain at that price thereafter. Such contract to provide that the city shall have the option at any time within 3 years after the date of contract to purchase from the water company, water and water rights for the city's own exclusive use, to an amount not exceeding 50,000,000 galls. daily, for the sum of $5,000,000, in addition to which such company shall then sell and deliver to the city, at their actual cost, any storage reservoirs hereafter built for the proposed supply especially designed for Newark; also at cost a conduit (with right of way free of cost) capable of delivering 25,000,000 galls. daily from an elevation sufficient to deliver the water into the Belleville reservoir, together with the right of way free of cost for an additional pipe capable of carrying another 25,000,000 galls. daily. If so desired by the city, however, one large conduit capable of conducting the whole 50,000,000 galls., or two conduits of a capacity of 25,000,000 galls. each, could at once be constructed.

The city must agree to take and pay for 14,000,000 galls. daily as soon as the works are in operation.

The third proposition, and the one concurred in by the committee, was from Mr. JULIUS H. PRATT and associates, offering to sell to Newark the property now owned by the North Jersey Water Co. for $75,000. This property embraces the entire Pequannock river for 3 miles, with sites for 3 large reservoirs, 500, 550 and 600 ft. above tide. It also includes the outlet of Macopin lake, with a right undisputed for 100 years to dam and draw down the water of the entire lake for a height of 4 ft. This purchase was to give Newark the control of the Pequannock water-shed and insure a daily average supply of 80,000,000 galls. The cost of storage reservoirs for 40,000,000 galls. daily is estimated at $150,000, including price of land; and the water can be stored at 300 or 400 ft. above tide on Orange Mountain. This proposition is supported by the estimates of Engineers W. E. WORTHEN, P. G. NOSTRAND, L. B. WARD, S. H. LOCKETT and WM. H. WHITE; made for projects including this water-shed.

After these reports were read, a special Committee was appointed to examine into the last one submitted. This Committee substantiated the figures given above and estimated that a pipe line of 25,000,000 galls. daily to Belleville reservoir would not exceed $1,875,000 in cost. The aggregate cost of 25,000,000 galls. of pure water daily was figured at $2,825,000 for all expenses, and the city would have in reserve a supply up to 80,000,000 galls. daily, which could be utilized as required. But the committee also reported that Mr. BARTLETT had purchased large tracts of land in this same water-shed, and they did not see how the PRATT Co. could guarantee the maximum supply promised, and they then recommended that a new proposition be made insuring Newark a maximum of 50,000,000 galls. daily at the point on the river included in the property of the North Jersey Water Co.

This request brought out a second proposition from Mr. PRATT, as follows;—A water company to be organized, owning lands and water rights on the Pequannock river, and to contract with Newark to furnish a domestic and public supply. This water was to be delivered by gravity under a head of 300 to 350 ft., and the company was to furnish 25,000,000 galls. daily, within 18 months of the date of the delivery of the contract; the contract to run for 25 years. The city of Newark is to pay $30 per million gallons, and is to have the option of purchase of the lands and rights of the water company on terms fixed in the contract. The company proposes to acquire further lands and to locate upon the Pequannock river, between Charlotteburg and Smithville, a reservoir at an altitude of not less than 450 ft. above tide, with a capacity of 50,000,000 galls. daily. It will build dams, etc., a 4 ft. conduit of wrought-iron or steel to the city of Newark and do all other necessary work. The option price fixed for a supply of 25,000,000 galls. daily is the sum of $3,950,000, and the rights guaranteed to the city. In return Newark is to assist the water company with its municipal powers, under the act of April 21, 1876, in acquiring for or by said city any lands or water rights which may be required.

After some discussion and minor amendments, this proposition was recommended to the special consideration of the Newark Aqueduct Board, provided that the option contained in said proposition be accepted immediately on the signing of the contract and that the guarantees on due investigation prove valid and sufficient. The city of Newark is authorized, under the law of April 2, 1888, to enter into an agreement with any water company, and its Aqueduct Board is empowered to act for it. The present water debt of Newark is a little more than $3,500,000, at 7 per cent., a large part due in 1892. At the next session of the Legislature an act will doubtless be passed for refunding its maturing water debt and to issue additional bonds for a new supply. Assuming $7,500,000 as needed for this, and that this loan can be negotiated at 4 per cent., the annual interest on the whole water debt would be $300,000 annually.

The Water-Power of New Jersey.

In the final report of Mr. GEO. H. COOK, the State Geologist of New Jersey, Mr. C. C. VERMEULE, C. E., in the portion devoted to the physical description of the State, treats of the water-power of New Jersey, about as follows:

In 1880 the total water-power utilized in manufactures was 27,036 horse-power, while steam showed 72,792 horse-power; thus showing that 27 per cent. of the total power was derived from water power. In 1870 the water-power figured at 44.4 per cent. This gain of steam over water is due to the increase of manufactures and the fact that water-power restricts the location of the manufactories, a feature that at times outweighs the advantages of cheaper power. But Mr. VERMEULE thinks that the water power of the State can be more fully utilized than is at present the case. Massachusetts uses 17.21 horse-power per square mile of area, against 3.63 per square mile in New Jersey. This latter State ranks eleven among the States in total power used; fifteen in water-power, eight steam-power, and in water-power per square mile she is ninth.

Some of the finest water-powers in the State are on the Passaic river and its branches. Between Little Falls and Dundee this stream falls 152 ft., and 40 ft. of this occurs in one mile at the former town; 70 ft. is in the single fall at Paterson and 21 ft. at Dundee dam. The area of the Passaic water-shed is given as 774.2 sq. miles above Little Falls, and 796.9 above Paterson. The exceptionally dry weather flow of Oct. 11, 1878, at Paterson, was 33,689,000 cu. ft. in 48 hours, or about 126,000,000 galls. per day. This was considered the smallest discharge for 30 years and was at the rate of a yearly flow of 3.32 ins. of water from the water-shed. It is safe to estimate that 12 ins. of the rain-

fall on the Passaic basin could be utilized by a system of storage reservoirs.

The prices now obtained for water by the Society for the Encouragement of Useful Manufactures, at Paterson, is as follows:—They lease and sell 300 cu. ft. per second for 12 hours in the day at the rate of $270 per cu. ft. yearly for the total fall of 70 ft. This quantity amounts to 5.14 ins. yearly from the watershed, the excess over the above minimum flow being secured by the long storage ponds in the stream channel, as the demand is only for a half day at a time. Estimating that 5 ins. of flow is available without new storage works, and that 140 ft. of the 152 ft. could be utilized, 12 ins. of yearly flow from the water-shed would be equal to 224,159 H. P. for 12 hours per day.

Other fine water powers are also noted, all within 40 miles of New York City. The Rockaway at Boonton drains 149.09 miles and falls 280 ft. in 2 miles. The Pequannock falls 500 ft. in 9 miles. The Highland region, Kittatinny valley, the Raritan and other localities are also described as water powers.

In 1885 the population of New Jersey was 1,278,133 and of this population 760,756, or about 60 per cent. are supplied by public water-works. But more than half of this number consume water of an unsatisfactory character; while 65,593, living in towns of 1,500 and upwards, are still unsupplied. With about half a million people wanting water, there is no lack of the pure article, as the Passaic river alone would deliver at Little Falls, with an elevation of 128 ft. above tide, enough water of excellent quality to supply 5,000,000 or 6,000,000 of people. The streams of the Archæan Highlands are unsurpassed in purity and are destined to remain unpolluted by reason of the rocky and wooded nature of the surroundings, and the very slight increase in population. Mr. VERMEULE hints at the danger of private corporations securing control of the areas needed to supply the people of the State.

In Southern New Jersey the streams are distinguished by a very even flow, with an average fall of 5 ft. per mile above the head of tide. But many fine water-powers are found upon them and much water-power still remains undeveloped.

The longest span of wire in the world is said to be a telegraph wire, in India over the River Kistnah, between Bezorah and Sectanagrum. It is more than 6,000 ft. long, and is stretched between two hills, each of which is 1,200 ft. high.

THE greatest active volcano in respect to eruptive force is probably Hecla on the south west coast of Iceland. Since A. D. 900, forty-three of its eruptions have been recorded, of which 5 were simultaneous or nearly so with those of Vesuvius and 4 with those of Etna, and 1 eruption with those of both.

A Holland Suction Dredge.

The firm of THOMAS FIGEE & Co., of Haarlem, Holland, has built for the Russian Government a suction dredge to be used in improving Baltic ports. A trial has recently been made with this machine by Russian officials in the port of Rotterdam, and it is pronounced a success.

The first experiment was in 8½ meters, or 28 ft., of water. In 35 minutes after the dredging-pipe was put at work, the tank aboard the vessel was loaded with 500 tons of fine sand mixed with clay. The motor was then disengaged from the pump and connected with the screw and the ship then took its load to the dumping ground. The load was discharged in a few minutes automatically without stopping the vessel. The average speed was 6.5 knots loaded and 7.4 knots unloaded.

The dredging boat is built of mild steel, and is 155.6 ft. long; 28.2 ft. wide and draws 11 ft. of water. The capacity of the debris-tank on board is 250 cu. meters, and she can dredge to a depth of 11 meters or about 36 ft. A crew of 13 men and 4 officers is requires. The motive power is a compound vertical engine with cylinders of 19¾ ins. and 32 ins. diameter and 16¾ ins. stroke. This engine can be connected either with the pump or the screw by means of a disk coupling.

The dredging apparatus consists of a centrifugal pump with a turbine 5.6 ft. in diameter. The suction pipe is 19¾ ins. in diameter, and the two entrance pipes into the debris-well have each a diameter of about 20 ins., with regulating valves. The dredging tube is hinged to the side of the ship, a little aft of the center of length, and can be hauled up under a protecting grating fender attached to the ship. The connection with the hull is by a strong leather sleeve with a protecting netting of heavy wires.

The debris-well is amidship and is provided with 12 close-fitting doors in the bottom of the hull, operated by a balance weight and chains. These gates can be shut in 2½ minutes after a load is discharged. The boat is described in *Le Genie Civil*, of Dec. 15., but the engravings accompanying the description show no details.

Depth of Evaporation in the United States.

We gave last week an interesting map showing by contour lines the comparative depth of evaporation throughout the United States. The following, reprinted from an article by Prof. T. RUSSELL in the "Monthly Weather Review" will explain how the observations were made, and give some further details in regard to them.

It has been proposed to find the depth of evaporation that takes place inside the thermometer shelters at the various Signal Service stations. For this purpose the relation has been determined between the evaporation observed at a few stations with Piche evaporometers and the condition of the air as to dryness reduced from the tri-daily readings of the whirled, wet, and dry-bulb thermometers. The relation between the evaporation as given by a Piche instrument, and what it would be from a water surface, has been determined by comparison at the Signal Office in Washington of the amounts of evaporation from the Piche with that from a cylindrical tin vessel 6.55 c. m. in diameter and 1.3 c.m. in depth, filled to the brim with water. The amounts of evaporation were obtained by weighings on successive days made to the nearest hundredth of a gramme by means of a fine balance.

Table III gives the computed depth in inches for each month and year. The chart (published last week) is based on this table. The lines join places having equal annual depth of evaporation.

It is believed that these figures represent approximately the evaporation that takes place from the surface of ponds, rivers, reservoirs, and lakes in the vicinity of the Signal Service stations.

This belief is based principally on the results of observations of evaporation and determinations of the humidity of the air from wet and dry-bulb thermometer readings made at Nukuss, from May to October, 1875, under the direction of the Central Physical Observatory at St. Petersburg.*

The observations were made by weighings of the evaporation from the surface of a pond by means of a vessel containing water immersed in the pond. Observations were also made of the evaporation from a water vessel on land, exposed in the sunshine, and from a similar vessel in a thermometer shelter. The wet and dry-bulb thermometers were read every two hours throughout the day during the whole time for five months that the evaporation observations were made. The results of the work were, as given by Stelling, that the humidity results, obtained from wet and dry-bulb readings with suitable constants, represented the evaporation from the surface of the pond within 15 per cent., and that the evaporation from the vessel in the sunshine for the average of five months was about 10 per cent. greater than that from the vessel in shelter. For one month, however—September—the evaporation in the shelter was about 3 per cent. greater than that in sunshine. The air is very dry at Nukuss. The depth of evaporation in June, in the sunshine, the greatest in five months, was 14.9 in.

Observations of evaporation in Signal Service shelters, from water dishes, would be very difficult. There are many difficulties in the way of observing evaporation from water dishes in the open air. The falling of rain splashes the water from the vessel or adds to it. When the temperature of the air is below freezing, it is impossible to get a fair measure of evaporation for a great part of the time, on account of the drifting snow. For the winter season the evaporation calculated by an empirical process from the dryness of the air, such as has been used here for the whole year round, is probably more accurate than any results of direct measurement.

It is acknowleged that the result of direct measurement of evaporation from water dishes, by weighing, would, on the whole, give a more satisfactory determination of the depth of evaporation than the process here resorted to, but the expense of procuring balances, and the great labor entailed on the men at stations by the method, forbid its use.

Even after evaporation is obtained from dishes, it is doubtful what it represents. Under the same circumstances of temperature and dryness of air, different shaped vessels will give different results for the depth of evaporation, presumably on account of the varying facility with which the vessel takes the temperature of the air, which depends on its shape, the material of which it is made, and its absolute size. A cylindrical vessel of the same bulk as a rectangular one exposes less surface to the air, and as the vessel gains its heat by contact with the air, it will usually not be at the same temperature as the rectangular one. Evaporation from the surface tends to lower the temperature, and the amount of lowering depends on the relation between the surface and the volume of water. At 8 p. m. as observed at Nukuss, this lowering of the temperature of the water in vessels amounted, on the average in June, to 9°.9 Fahr.

But greater than all other things in its effects on the depth of evaporation from vessels, is the effect of the depth of the water surface below the rim of the vessel. In the case of a vessel of circular section 2.5 ins. in diameter, the evaporation, when brimfull, is about 50 per cent. greater than when the water surface is 0.3 in. below the rim.

*Band viii, No. 2, of Wild's "Repertorium für Meteorlogie," 1882.

Even if a satisfactory size and shape of vessel for observation of evaporation could be settled upon, it is very doubtful how nearly evaporation from it would represent the actual evaporation from the surface of a neighboring pond or river, owing to the uncertainty of the effect of the wind. Wind promotes evaporation powerfully, as will be seen further on. But, by means of wind velocities, as measured by anemometers high up in the air, it is hard to estimate the effects of wind on evaporation from a pond or river sheltered by trees or high banks.

For any particular place the most satisfactory way to obtain the depth of evaporation would be by a special investigation for that place.

The Piche evaporometer (see figure) consists of a glass tube 9 ins. long and 0.4 of an inch internal diameter. The top end is closed and has an eye for suspending the instrument. The tube is filled with water and on the open end a paper disk 1.2 in. in diameter is placed and held in position by a brass fixture sliding easily in a collar along the tube. Water is supplied to the paper from the tube by capillary action, and evaporates freely from it into the air, the amount depending on the dryness of the air and the velocity of the wind. There is a scale etched on the tube to cubic centimeters and tenths. The difference in the readings of the top of the column of water gives the volume evaporated from the paper in the interval between the readings.

Twenty-five of these instruments were procured for the Signal Service, and observations were made daily with eighteen of them at various stations, from May 31 to Sept. 30, 1888.

A few of the instruments were calibrated with mercury to test their graduation and were found to be very exact, except in the case of the one sent to Yuma, which was discovered by the observer to be graduated incorrectly below 17 cu. m. by one whole cubic centimetre. The paper disks supplied to the stations were all exactly of the same diameter, and the paper all of the same kind, thin, not over one hundredth of an inch thick, and unsized. The brass circular disks holding the paper in place on the tube were all measured and found to have the same diameter within one-tenth mm. The external diameters of the tubes, when in contact with the paper, varied from 14.0 mm. to 15.6. The amount of paper surface exposed to the air was taken as twice the area of the paper disk, minus the area of the end of tube, minus the area of brass disk. The amount of surface exposed by the edge of the paper was neglected. Even if this surface was appreciable, it is allowed for by the method of standardizing the evaporometers by reference to the water dishes.

The amount of paper surface exposed in the various evaporometers varied from 11.0 sq. cu. m. to 11.4, as follows: (omitted.)

These instruments were mounted in the thermometer shelters at the stations. They were read once a day at 10 P. M. during June, and at 8 P. M. during July, August and September. The difference in the readings on successive days gave the amount of evaporation for the various days.

The following series of results shows what may be expected in the way of agreement among different instruments:

DEPTH OF EVAPORATION, IN MILLIMETRES, IN QUIET AIR.

Date.	Dish A.	Dish B.	Piche No. 2.	Piche No. 3.	Coefficients	
					No.2.	No.3.
1888.						
June 27 to 28....	1.03	1.03	1.36	1.38	1.32	1.34
June 28 to 29....	1.04	1.01	1.45	1.46	1.41	1.42
June 29 to 30....	0.80	0.83	1.37	1.41	1.67	1.72
June 30 to July 1	0.70	0.76	1.32	1.35	1.82	1.85
July 1 to July 2.	0.89	0.96	1.66	1.72	1.79	1.86
July 2 to July 3.	0.89	.....	1.79	1.86	2.01	2.09

The shelters on Signal Service stations are usually at a height of 9 ft. above the roof of building where situated. The shelter is a cubical box 3 ft. on a side, with the sides of open louvre or lattice work, and a close board bottom and a close double top. It opens by a hinged louvre-work door to the north, which is kept closed except while observations are being made.

To determine the relation between the evaporation from a water surface and that from the Piche, two Piches were compared, in the quiet air of a closed room, with two tin dish-evaporometers, each 6.55 c. m. in diameter and 1.3 in depth. In these experiments the Piches were weighed from day to day, as well as the dishes, and not read by the etched scales, as was the case with those on stations.

The results of the experiments showed that the rate of evaporation from the dishes, diminished regularly as its water surface fell below the edge of the vessel. The Piches evaporated 1.33 times that of the dishes, surface for surface as compared with the dishes while quite full. The coefficient increased to 2.05 as the surface of the water in dish fell.

The coefficient used to reduce the Piche evaporations on stations to an equivalent water surface was 1.33. This was the mean obtained from all the observations with the vessels quite full, as long as the water surfaces did not fall more than 1.5 mm. below the edges of the vessels. All other observations with the surfaces below this limit were rejected.

The coefficient of a similar instrument, as determined by Prof. M. KUNZE by comparison with evaporation from a metal dish with a surface of 250 sq. cm. (about eight times that of the above), was found to be 1.42 as given by the mean of comparisons from April to October, 1880.

The increasing coefficient, as previously stated, is due to the fall of water surface below edge of vessel.

In Table I are given the depths of evaporation observed with the Piche instruments on stations, reduced by the coefficient 1.33

TABLE I.—DEPTH OF EVAPORATION, IN INCHES, OBSERVED WITH PICHE INSTRUMENTS, AND AVERAGE WIND VELOCITIES, IN MILES PER HOUR.

Station.	June, 1888.		July, 1888.		August, 1888.		Sept., 1888.	
	Inches.	Miles.	Inches.	Miles.	Inches.	Miles.	Inches.	Miles.
Boston	5.16	10.2	5.87	10.8	5.28	11.3	2.68	9.6
New York	4.49	8.3	5.36	8.4	4.14	9.0	2.88	8.2
Washington	4.64	4.8	4.27	4.5	4.22	3.9	2.52	4.4
Buffalo	.....	.....	.....	.....	.....	.....	3.70	8.1
Cincinnati	6.22	6.1	6.93	5.7	5.36	5.6	4.33	6.4
Memphis	4.33	4.8	5.24	3.9	4.57	5.4	3.86	5.1
New Orleans	3.82	6.8	9.38	6.0	7.96	8.0	3.70	6.3
Chicago	5.59	10.3	5.52	8.7	6.97	10.4	5.79	9.3
St. Louis	6.18	9.7	5.79	7.9	4.41	8.2	4.61	8.6
Keeler	11.66	7.9	12.76	6.8	12.69	5.4	10.95	6.0
Yuma	13.87	7.3	13.65	7.2	12.88	5.9	10.36	5.4
El Paso	13.91	8.2	9.89	7.2	11.54	8.0	10.00	5.4
Dodge City	7.80	11.6	8.20	12.0	6.22	9.8	6.07	....
San Antonio	2.76	8.1	5.08	7.1	5.36	7.7	3.66	5.8
Omaha	7.01	7.6	6.62	7.0	5.44	6.8	6.78	7.3
Denver	9.42	8.0	10.91	6.7	8.55	6.2	5.94	....
St. Vincent	5.63	7.6	4.33	7.4	4.97	7.5	.....	9.4
Helena	4.88	7.9	8.20	7.1	7.80	6.2	6.86	6.7
Boisé City*	5.83	3.1	9.14	2.2	7.68	1.5	.....	2.6

* Boisé City, October, 7.60 inches.

The amount of evaporation depends principally on the dryness of the air and the velocity of the wind blowing over the evaporating surface. The measure of the dryness of the air is the difference in vapor tension corresponding to the temperature of the air and that corresponding to the temperature of the dew-point.

The wind prevailing inside the shelters is much less than that outside shown by the anemometers. These latter are the ones given in table above.

At Washington City, in the shelter at new office (not the same one as that in which evaporation above given was observed) the wind velocity, by an anemometer set up inside the shelter for eight days, gave a result of 3.48 miles an hour as compared with a velocity of 6.63 miles outside, only 52 per cent. of the velocity outside.

It has been found impossible to make any satisfactory allowance for the wind effect varying with velocity in the observations of evaporation given here on account of the interference with the wind produced by the sides of the shelter. The wind effect has been therefore left out of consideration in this work, except in so far as its effect at all places is taken to be uniform. The figures here given for depth of evaporation must be viewed as applying for the average state of the wind, which, all the year round at stations of the Signal Service does not, on the average, amount to more than 8.5 miles per hour.

A scrutiny of the results of evaporation for single days at the various stations shows it to depend more largely on the dryness of the air than the wind travel for the day.

Depth of Evaporation at Boston.

At the W-Wks. reservoir.		At the Signal Service station	
Month.	Ins.	Inches.	
January	0.90	1.62	Computed 1888.
February	1.20	1.81	Do.
March	1.80	2.25	Do.
April	3.10	3.22	Do.
May	4.61	4.46	Do.
June	5.86	5.16	Piche observed, 1888.
July	6.28	5.87	
August	5.49	5.28	
September	4.09	2.68	
October	2.95	2.65	Computed, 1887.
November	1.63	2.21	Do.
December	1.20	1.46	Do.
Year	39.11	38.67	34.40 July, 1887, to July, 1888.

Depth of Evaporation in Inches.

Month	Milwaukee.			Mean.	Chicago, 1888. Piche.
	1862	1863	1864		
April	.....	3.04	2.65	2.84	.....
May	4.32 (27)	3.59	8.16(29)	3.53	.....
June	5.54	5.41	7.35	6.10	5.59
July	6.49	5.18	7.45	6.37	5.52
August	5.04	4.73	4.78	4.85	6.97
September	3.83 (27)	4.00	2.00	3.28	5.79
October	3.06	.....	.....	3.06	.....

Experiments were made which show that the effect of the wind on the evaporation from a vessel exposed in the open air is very great. Two Piche instruments were taken, one suspended in quiet air and the other fixed rigidly on the end of the 24-foot arm of the whirling machine set up in the enclosure of the Pension Office building. The whirling machine was the one used in standardizing anemometers. The instruments filled with water, were first weighed on a fine balance to the hundredth of a gramme. The whirling arm was then turned so that the Piche on its end moved with a velocity of five miles an hour. The motion was continued for half an hour, and at the end of the time both Piches were again weighed. Then the Piche that had been suspended in quiet air was put on the arm, and the one that had been on the arm was put in its place. The whirling was then started again at the same velocity, and continued for another half hour. At the end of the time the Piches were again weighed. While this was being done the humidity of the air was determined from time to time by means of whirled wet and dry-bulb thermometers.

Observations were also made in the same way with the Piche moving at velocities of 10, 15, 20, 25 and 30 miles per hour. At a velocity of 5 miles an hour the evaporation from a Piche was 2.2 times that from one in quiet air; at 10 miles, 3.8 times; at 15 miles, 4.9 times; at 20 miles, 5.7 times; at 25 miles, 6.1 times; and at 30 miles, 6.3 times. During the time the observations were made, June 25 and 26, 1888, the average temperature of the air was 83.7, and the relative humidity 50 per cent.

[Preliminary details giving in full and with great care the method of deducing the following formula for reducing observations are omitted.—ED.]

The evaporation for July to December, 1887, and January to July, 1888, given in Table III., have been computed by the formula—

$$30\left(\frac{A\,p_w + B\,(p_w - p_d)}{b}\right)$$

p_w is the vapor tension corresponding to the monthly mean of the wet-bulb thermometer; p_d is the vapor tension corresponding to the monthly mean dew point; b is the mean barometer reading; A is a constant equal to 1.96, and B, a constant equal to 43.9. The quantities obtained from the above formula have been multiplied by a factor 1.03 for months of 31 days and divided by 1.03 for February. These latter are the quantities given in the table, and they represent evaporations inside of the shelters when the velocity of the wind outside is 7.1 miles per hour. This is the mean of the velocities at the stations during June where the Piches were observed. This probably corresponds to a velocity inside the shelter of 3.5 miles per hour.

The results derived in this way for Boston can be compared with a very elaborate series of observations of evaporation made at the reservoir of the Boston water-works by Mr. FITZGERALD.* These observations were made by measuring the evaporation from a large vessel filled with water and immersed in the reservoir. A raft was floated in the reservoir center for the purpose of making the observations. Mr. FITZGERALD concludes from his experimental work that there was no difference in the amount of evaporation from vessels in sunshine and shade. The results of the work, as given below, are for a different year from that in which the Signal Service observations were made.

The mean annual evaporation at the Croton water-works reservoir, New York, quoted by Mr. FITZGERALD, is 39.21 ins. The evaporation at New York City Signal Service station, as found here, is 40.6 ins.

An extensive series of evaporation experiments was made at Milwaukee in 1862, 1863 and 1864, from April to October. They are given in detail for each day in the Report of the Chief of Engineers for 1867. The results for the months are given below with the evaporations alongside of them as observed at Chicago by means of the Piche evaporometer in 1888. The Milwaukee observations were made by weighings of a large shallow vessel filled with water and set up inside a thermometer shelter. The incomplete observations, twenty-six days, twenty-seven days, etc., are probably due to loss of the observations caused by rain.

As regards the accuracy with which the figures for evaporation given in Table III. represent the actual evaporation from ponds, rivers and lakes, the following may be remarked.

The effect of the high exposure of the shelters is to make the figures too great, the wind action being far greater at the height of the shelters than the level of the ground. The evaporation taking place from a small paper disk, as in the results obtained with the Piche instrument have a tendency to be too small, as the determining temperature of evaporation is that of a wet-bulb thermometer exposed under similar circumstances. In the case of a body of water the determining temperature of evaporation is nearly that of the average temperature of the air. In the sunshine it is far above the air temperature in the case of shallow water. The results are probably within 20 per cent. of the truth.

In conclusion it must be stated that these figures only represent possibilities of evaporation and not actual evaporation over the whole surface of the country. If a set of figures were prepared for the various parts of the country which would represent the opportunities of evaporation which depend on the relative amount of land and water surface and on the wetness or dryness of soil and the amount and character of vegetation, the product of the two sets of figures would be the absolute evaporation.

[We give only a few of the stations reported in the following Table III.]

TABLE III. DEPTH OF EVAPORATION, IN INCHES, AT SIGNAL SERVICE STATIONS, IN THERMOMETER SHELTERS, COMPUTED FROM THE MEANS OF THE TRI-DAILY DETERMINATIONS OF DEW-POINT AND WET-BULB OBSERVATIONS. [We include only a few from a long list.—ED.]

Stations and Districts.	Jan., 1888.	Feb., 1888.	Mar., 1888.	April, 1888.	May, 1888.	June, 1888.	July, 1887.	Aug., 1887.	Sept., 1887.	Oct., 1887.	Nov., 1887.	Dec., 1887.	Year.
New England.													
Portland, Me	1.0	1.2	1.8	2.6	1.8	3.3	3.8	3.9	3.4	3.0	2.5	1.4	29.7
Boston, Mass	1.2	1.6	2.2	3.4	3.1	4.7	4.4	4.0	3.5	2.7	2.2	1.4	34.4
Middle Atlantic State.													
Albany	0.9	1.2	1.6	3.3	3.9	4.5	5.0	4.7	3.2	3.0	2.1	1.4	34.8
New York	1.8	1.4	2.0	3.4	3.3	4.6	5.0	5.2	4.3	4.1	3.3	2.2	40.6
Philadelphia	1.6	2.1	2.5	4.4	4.0	5.7	5.7	5.2	4.3	4.0	3.3	2.2	45.0
Atlantic City	1.2	1.6	1.5	2.4	1.8	3.6	2.9	3.3	2.4	1.8	1.2	1.5	25.2
Baltimore	2.0	2.2	2.8	5.1	4.7	5.6	6.0	5.0	4.4	4.3	3.6	2.4	48.1
Lynchburg	2.6	2.7	3.4	5.2	4.5	5.8	4.7	4.3	3.3	3.4	3.2	2.6	45.5
South Atlantic States.													
Wilmington	2.4	2.2	2.7	3.3	3.3	4.3	4.3	3.1	3.9	3.4	2.8	2.7	38.4
Charleston	3.5	3.5	3.5	5.7	3.9	4.4	4.5	4.8	4.2	4.0	3.2	2.5	43.7
Columbia	3.2	2.3	2.6	4.8	4.3	5.4	4.2	3.8	4.2	3.4	3.6	2.4	43.2
Augusta	3.0	2.6	3.4	5.3	4.8	5.0	4.8	4.5	5.1	4.1	3.6	3.1	49.3
Jacksonville	2.9	2.6	3.8	4.3	4.6	5.3	5.0	4.7	3.8	3.6	3.0	2.1	45.7
Key West	3.8	3.7	3.8	4.5	4.4	4.8	5.1	5.1	4.7	4.3	3.8	3.6	51.6
Eastern Gulf States.													
Atlanta	2.7	2.6	4.0	6.2	4.7	5.0	4.5	4.7	5.8	4.6	4.2	2.5	51.5
Pensacola	2.9	2.8	4.1	4.0	4.3	4.6	5.0	5.4	5.2	4.5	3.6	2.4	48.8
Montgomery	3.5	3.3	5.1	6.5	5.9	5.8	4.3	4.5	5.7	4.6	4.3	3.1	56.6
New Orleans	2.8	2.8	4.1	3.8	4.2	4.1	4.1	4.3	4.4	4.6	3.7	2.5	45.4
Western Gulf States.													
Shreveport	1.6	2.1	3.0	4.8	4.9	4.2	4.9	5.2	5.0	4.1	3.4	2.4	45.6
Little Rock	2.1	2.8	3.5	5.5	4.8	4.1	5.4	5.9	5.8	5.2	4.3	2.3	51.7
Galveston	1.6	2.8	3.2	2.9	4.3	4.5	5.3	5.2	5.2	4.7	4.2	2.4	46.0
San Antonio	2.4	3.3	4.1	3.8	4.0	4.5	6.6	5.8	5.2	5.4	4.2	3.1	52.4
Ohio Valley and Tennessee.													
Chattanooga	2.0	3.3	3.3	5.3	3.7	4.3	4.3	5.0	5.4	4.0	3.9	1.9	46.4
Memphis	2.1	2.3	3.1	5.9	5.3	4.8	4.9	5.4	5.5	4.2	4.1	2.4	50.0
Louisville	1.7	2.1	2.8	5.6	5.4	5.8	6.8	7.4	6.4	4.9	3.8	2.1	54.8
Indianapolis	1.3	1.4	2.2	4.6	4.8	5.7	7.7	6.9	5.2	4.1	3.1	1.6	48.6
Cincinnati	1.8	1.8	2.6	4.9	5.2	6.4	6.5	6.6	6.1	4.7	3.3	2.1	52.0
Pittsburg	1.4	1.9	2.2	3.8	4.2	5.4	6.6	5.6	4.9	3.4	2.8	2.3	44.5
Lower Lake Region.													
Buffalo	0.8	1.1	1.3	2.2	3.3	3.9	4.9	5.2	3.9	2.8	1.9	1.6	32.9
Cleveland	1.1	1.4	1.5	2.9	3.3	4.4	5.2	4.9	3.8	3.4	2.4	1.4	35.7
Toledo	0.9	1.1	1.5	3.5	3.8	4.6	6.0	6.4	3.7	3.4	2.4	1.3	38.6
Detroit	0.8	1.1	1.6	3.0	4.1	4.8	5.9	5.2	3.4	2.8	2.0	1.3	36.0
Upper Lake Region.													
Alpena	0.7	0.6	0.9	1.6	2.1	3.6	3.8	3.7	2.8	2.2	1.5	0.8	24.3
Grand Haven	0.5	0.7	1.3	2.6	3.1	3.8	4.7	3.8	2.7	2.6	1.7	1.1	28.6
Marquette	0.8	0.8	0.9	1.7	2.4	3.3	3.4	3.3	3.1	2.2	1.3	1.3	24.5
Chicago	1.0	1.2	1.8	3.2	3.3	4.8	5.4	5.3	4.1	3.2	2.3	1.2	36.8
Milwaukee	0.5	1.0	1.1	2.4	2.6	3.8	4.8	3.7	3.4	2.9	1.9	0.9	29.0
Duluth	0.5	0.5	0.6	1.5	2.4	2.5	3.9	3.4	3.0	2.5	1.2	1.0	23.0
Extreme Northwest.													
Saint Vincent	0.3	0.3	0.5	1.8	3.8	3.9	3.1	2.6	2.6	2.0	0.9	0.3	22.1
Bismarck	0.4	0.6	0.6	3.0	4.3	4.1	5.6	4.2	4.0	2.6	1.2	0.4	31.0
Fort Totten	0.2	0.3	0.4	2.2	4.6	3.8	4.2	3.7	3.7	2.3	1.4	0.4	27.2
Upper Mississippi Valley.													
St. Paul	0.7	0.7	2.2	2.0	2.3	4.1	5.0	3.7	2.8	2.4	1.5	0.7	28.1
Des Moines	0.6	1.0	1.5	3.7	3.1	4.2	6.6	4.7	4.1	3.3	2.3	0.9	36.0
St. Louis	1.3	1.6	2.5	5.5	4.7	5.0	7.5	8.0	5.9	4.9	3.9	1.4	52.2
Missouri Valley.													
Springfield, Mo	1.1	1.7	2.4	5.0	4.8	4.0	5.0	3.4	3.4	3.5	3.1	1.4	38.3
Topeka	1.1	1.2	2.0	4.6	4.1	4.1	6.3	3.5	3.2	3.0	2.2	1.4	36.1
Omaha	0.8	1.5	1.4	4.4	3.8	5.2	6.2	5.2	4.3	4.3	3.0	1.4	41.7
Yankton	0.4	1.4	1.2	3.3	3.4	4.4	4.6	3.7	2.9	3.0	2.2	0.8	31.0
Northern slope.													
Fort Assiniboine	0.8	1.2	1.2	3.8	4.1	4.2	6.8	5.5	4.8	3.5	2.5	1.1	39.5
Helena, Mont	1.1	3.6	2.1	6.1	4.3	5.5	7.2	7.7	6.4	4.3	3.0	2.1	53.4
Cheyenne	3.3	5.7	4.0	8.2	5.2	10.4	8.0	7.7	8.6	5.8	6.1	3.5	76.5
North Platte	0.8	1.8	1.8	5.4	3.9	6.9	6.0	4.8	3.7	2.8	2.3	1.1	41.3
Middle slope.													
Colorado Springs	3.0	3.3	4.1	6.7	5.6	4.3	6.7	7.2	6.8	4.6	4.2	2.9	59.4
Denver	2.8	3.7	3.5	7.6	5.8	10.5	8.3	8.5	6.1	4.9	4.2	3.1	69.0
Pike's Peak	2.1	1.3	1.5	2.1	1.8	1.9	3.0	4.0	3.0	2.3	2.8	1.0	26.8
Southern slope.													
Abilene, Kan	1.8	1.7	3.1	4.2	5.0	5.8	9.5	7.5	6.2	4.5	3.4	1.7	54.4
Fort Davis	5.4	5.7	6.7	8.5	11.0	12.0	11.4	9.0	5.9	5.2	5.7	4.9	96.4
Fort Stanton	3.9	3.9	5.2	7.3	9.5	10.9	9.4	11.6	3.9	4.0	3.6	3.8	76.0
Southern plateau.													
El Paso, Tex	4.0	3.9	6.0	8.4	10.7	13.6	9.4	7.7	5.6	5.2	4.6	2.9	82.0
Santa Fé, N. M.	3.0	3.4	4.2	6.8	8.8	12.9	9.2	9.8	6.6	6.7	5.7	2.7	79.8
Yuma, Ariz	4.4	5.2	6.6	9.6	9.6	12.6	11.0	10.2	8.2	8.2	5.5	4.6	95.7
Middle plateau.													
Salt Lake City	1.8	2.7	3.6	7.2	6.9	8.9	9.2	10.7	9.6	6.5	5.0	2.3	74.4
Northern plateau.													
Boisé City	1.6	2.5	3.8	6.1	6.5	6.6	10.0	9.2	7.4	5.2	3.2	1.8	63.9
Spokane Falls	0.7	1.7	2.7	4.4	5.4	4.4	7.7	6.4	3.8	2.5	1.7	1.4	42.8
Walla Walla	1.1	2.9	3.6	6.2	7.7	5.7	9.9	7.9	5.1	3.4	1.8	2.4	57.7
North Pacific coast.													
Olympia	1.3	1.2	1.8	2.5	4.1	3.3	3.2	3.1	2.4	1.5	1.3	1.1	26.8
Astoria	1.1	1.0	1.6	2.1	3.0	2.7	3.0	2.9	2.6	2.3	1.8	1.2	25.3
Portland	0.9	1.1	2.4	3.4	5.0	3.2	5.4	4.2	3.4	2.7	1.8	1.2	34.7
Middle Pacific coast.													
Sacramento	1.8	3.1	3.7	4.3	4.2	5.6	5.9	5.6	6.5	7.3	3.9	2.4	54.3
San Francisco	2.7	2.7	3.3	3.1	2.8	3.1	2.4	2.5	3.3	5.0	2.8	3.0	36.7
South Pacific coast.													
Fresno	1.8	2.8	3.0	5.6	6.0	7.0	9.1	10.2	7.6	6.7	3.8	2.2	65.8
San Diego	2.9	2.7	2.5	2.7	3.3	2.8	3.2	3.3	2.9	4.3	3.2	3.7	37.5

*Transactions of the American Society of Civil Engineers, Vol. XV., 1886.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL

Published Weekly at Tribune Building, New York.

VOL. XXI. Saturday, January 5, 1889.

D. McN. STAUFFER, A. M. WELLINGTON.
EDITORS.
GEO. H. FROST. - - - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year*; $2.50 *for Six Months*; $1.50 *for Three Months*; *Single Copies*, 12 *cents*. FOREIGN COUNTRIES, $6.56 *per Year, or* 3 *cents per number additional.*

Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Civil Engineers' Society of St. Paul, Minn. — Regular meeting, Jan. 7. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of Kansas City, Mo.—Regular meeting, Jan. 7. Secy., Kenneth Allen, Y.M.C.A. Building.

THE progress of time again enables us to wish each and all of our readers a happy and prosperous New Year; which we think, on the whole, most of them may hopefully expect; and to thank them for the interest and appreciation which they have shown in our efforts to produce at last in this country a worthy organ of the engineering profession. They will, we are sure, be glad to know, and as *quasi* partners in the enterprise they have a certain right to know, that their generous support has caused an increase of no less than 39 (38.89) per cent. in the regular circulation of ENGINEERING NEWS within the calendar year 1888, against 28 (28.12) per cent. in 1887 and 19 (18.62) per cent. in 1886, a total increase of 113 (112.64) per cent. within three years, starting from a circulation which was then fairly large for a journal of this class, and just 67.4 per cent. of the then largest technical circulation in the United States. Warned by past experience, we make with this issue a still further increase of 15 per cent., (32 per cent. of all we had three years ago,) to be stowed away *pro tem.* in back numbers, to provide for a demand which we have learned to expect.

Nothing like such an increase has ever been known in the United States or elsewhere, we are safe in saying. We do not often talk about ourselves, but we make an exception of an occasional New Year's day; and it is with just pride that we add that this result has come about without resort to any of the usual devices for galvanizing moribund journals into life; without traveling canvassers; without giving a single new subscriber a cent of discount or other inducement; (except to a few unsolicited clubs) and without the personal solicitation of any one to become a subscriber unless by our other subscribers and friends.

We will only add that, ENGINEERING NEWS will enlarge in its next and all succeeding issues to 22 pages, and shortly after (as soon as we can complete arrangements to properly fill the space) to 24 pages, which is 50 per cent. more than is published by any other technical journal in this country and as many as are published by any such journal in the world. No one has asked us to do this, and it costs us money, but if we can stand it we presume our readers can, since it costs them nothing. The best promise in regard to the additional matter which will fill the additional pages will be fulfillment; and therefore, we will only end as we began by wishing all our readers a Happy New Year and many of them.

OUR esteemed Chicago contemporary, the *Railway Age*, publishes a summary of railway construction for 1888 which does more credit to its enterprise in grouping together as "new railway construction" every road on which two parallel tracks were laid for wheeled vehicles to run over, than to its care in determining what was and what was not a railway in the now accepted technical sense of a permanent line which is *a common carrier of both freight and passengers by regular trains*, thus excluding logging roads and the like on the one hand, and motor lines, and certain so called "junction" lines on the other, the last are generally either mere switches or for passenger traffic only. Possibly our contemporary was led to be careless in respect to the lines it included, by a desire to approach more closely to its rather hasty prediction made early in the year that the construction of 1888 was likely to be 10,000 miles or over; but at any rate it publishes a summary showing 365 lines aggregating 7,120 miles, instead of 286 lines aggregating 6,430. Our contemporary does not publish a detailed list, as we do, and therefore we cannot determine to what extent the difference may be genuine, but that the bulk of it is due to the inclusion of lines of the class above noted, which are not railways at all in the technical sense, becomes at once apparent on cursory examination. Thus in the State of Michigan, in which a sporadic crop of logging roads is a feature of each succeeding season, and in which, by a singular coincidence, there is the greatest discrepancy between their record and our own, they report 23 lines aggregating 347 miles, while we report only 7 lines aggregating 245 miles, a difference of 16 lines and 102 miles. We are able to trace the cause of a large part of this difference, and to state that it is due almost wholly to improperly included mileage.

IN another part of the same issue of the *Age*, the Michigan Central system is credited with "63½ miles of which 60 miles were in Michigan." As reported to us by Chief Engineer HAWKS, 56 miles of this consisted of "extensions and branches *for freight*", and that mileage was therefore omitted from our list, as it should have been from the *Age's*.

There remains an aggregate of only 46 miles to distribute among 15 lines, and we count up as much mileage as that of the ambiguous class referred to. In a similar way we might include a second road of 20½ miles of similar (lumbering) mileage in Pennsylvania and New York out of a total difference of 39 miles, and similarly likewise the *Age* credits the Denver & Rio Grande system with 23.42 miles in Colorado, while Chief Engineer R. E. BRIGGS reported to us that all but one short branch 2 3-10 miles in length were coal or lumber branches, leaving a difference of 24 miles built on 7 lines, or 3 + miles each, probably motor lines and sidings.

On the other hand, we find that we have reported for Florida 49 miles more than the *Age*, on 4 different lines, 10 miles more in Alabama, 16 in Arkansas (and we have since learned of 18 miles more) and like excesses in other States, practically all of which we think is genuine. We are quite ready to concede in turn that the *Age* record may have equally legitimate grounds for some excess over our own in some of the other States. All such early statistics are subject to revision; but we object to a reckless fashion of including some hundreds of miles of alleged construction in a record which purports to give only the increase of *railways* in this country, or lines which run regular trains for the transportation of freight and passengers. The *Age* is not doing itself or the public any good by such previousness, which has a decided tendency to mislead.

SINCE our last week's issue was published, Chief Engineer A. L. STANNARD of the Davenport, Iowa & Dakota, writes us that track has just been laid on this new road from Davenport northwest to a connection with the Burlington Cedar Rapids & North Ry., in Cedar county, a distance of 31 miles. It should perhaps be stated also that two or three motor lines have been built in the State for suburban passenger traffic only, which are not included in our statistics. Such roads as these have not thus far been meddled with by the Iowa legislators, and the Davenport road, if we are rightly informed, has been built thus far principally by township subsidies and small subscriptions by Davenport men. The fact to which attention has frequently been called, that anti-railway legislation puts a check on railway extension, is no less conspicuous because of this trifling construction.

THE American Society of Civil Engineers might well learn a lesson from the Engineer's Club of Philadelphia (as from many other such societies) in regard to the proper manner of nominating and electing its officers. The club's ballot for officers, just received, is for the election of a President, Vice-President, Secretary and Treasurer, and *five* directors. *Two* names of candidates for President and *seven* names of candidates for Directors are printed on the ballot (but not in alphabetical order, as they should be) with the following directions in regard to this surplus of names:

"Draw a distinct line across the names of all candidates except those for whom you desire to vote. That your vote, in this case, may be regular, you should, at least, cross off one candidate for President and two candidates for Director."

This form insures a real election; a real choice by the membership, and consequently a real interest in the election. The Institution of Civil Engineers elects annually a President, 4 Vice-Presidents and 15 Directors, 24 names being put in nomination for the latter office, at least 9 of which must be struck off by the voter to have the ballot counted. Such a provision works well in another way by throwing out completely the votes of those who do not take interest enough in the matter to prepare their ballots correctly. The Am. Soc. C. E. system simply lays before the voter a cut-and-dried ballot, which he may vote or not as he pleases without any chance of his vote having any effect either way unless there is an opposition ticket in the field; and it provides no really adequate and proper channel for putting such a ticket in the field, as the existence of an anonymous opposition ticket this year illustrates. We have every reason to believe that that ticket is really supported and put forth by a group of members amply sufficient in numbers to warrant the putting forth of an opposition ticket if they so desired, and it is possible, in fact, that this opposition ticket was officially issued by the society under the following clause of the By-Laws:

SECTION 24,-5th. Any five members, not officers of the Society, may present to the Board of Direction, on or before Dec. 1, a list of names proposed by them for officers *which list or lists shall also be issued for ballot.*"

BUT whether so officially issued or not, the manner in which it is issued, without the slightest mark to indicate its origin, or that it was not the "regular" ticket, is certainly objectionable; for the reason that there is nothing to prevent a single member issuing a set of ballots anonymously, before or after the issuance of the regular ballot, and so deceiving many; but under the present system of nominating and electing officers the issuance of an opposition ticket has such an exceedingly unpleasant semblance to a personal

attack upon candidates that we do not wonder that members shrink from it, even though their opposition springs from the purest motives. Properly speaking, it is no reflection on a candidate that we prefer some other man to him; but when the whole machinery of election is so organized that the expression of such choice is not supposed to be normally necessary nor desirable, the exceptional proposal of a new candidate becomes something very personal indeed.

The true remedy is to make and complete the nominations at the Annual Convention, which is the best possible "nominating committee", and affords a good chance to do, what is now not done, "feel the pulse of the Society." It should then be provided that there shall be at least a specified number of extra names nominated, some of which must be stricken out; so as to require some positive act of choice by the voter to have his ballot count.

Perhaps the best means of securing these extra names, which would secure likewise another highly desirable end, would be to make all the old officers candidates *ex officio*, and then provide for the nomination of another complete list, the two to be printed together in alphabetical order without distinction. Thus the old officers would have a certain advantage, which they ought to have, from being known to many as such. It would be only by a distinct choice of the Society that they would be turned out of office or kept in; instead of the decision resting on the whim of two or three men. It is also worthy of consideration whether the principle of cumulative voting could not be introduced to advantage, entitling a man, if there were 15 directors, to cast 15 votes for whom he pleased, either for 1, 2, 3, 5, 10 or 15 different persons. This would provide effectually for the representation of minorities, which will become increasingly important as the Society grows larger, and would enable members who only happen to know 6 or 8 or 10 of the nominees to vote intelligently, without being compelled to strike out at random names which meant nothing to them. The system is in successful use in a large number of societies, as also in the general electoral system of England, where it is a standard petition to "plump for Smith", meaning to give Smith all of the votes at the voter's disposal, instead of dividing them among others. Abstractly this is much the fairer system. The objection to it for general use is that it requires a certain intelligence in the voter. This objection would not apply to a body like the Am. Soc. C. E.

BUT the manner of nominating and electing is only one of several defects in the Constitution of the Am. Soc. C. E., which imperatively demand remedy if the Society is to prosper.

That long suffering instrument has been patched and re-patched out of all semblance to its former self, and is in many parts needlessly verbose and obscure, as well as inadequate in its substance. Pressing necessities, besides those outlined, are to enlarge the Board of Direction; to distinguish between its vitally important and merely routine duties: to reduce the number of meetings of the full Board, at which the general policy of the Society is fixed, to 3 or 4 per year (or perhaps only two, at the Convention and Annual Meeting) so that its general policy and the distribution of its expenditures may be fixed by a body truly representing all sections and opinions; relegating the routine duties, like action on applications, to a Committee of the whole with a less number as a quorum. Another needed change is to take the two permanent executive officers, the Secretary and Treasurer, from the Board of Direction, and make them electable by that Board, whose officers they are, instead of by the whole Society. It appears to us likewise that it would be highly desirable to provide that only Directors or ex-Directors should be eligible for Vice-President, and only Vice-Presidents or ex-Vice Presidents be eligible for President for several reasons which we will not go into. When to this is added the need for some revision of the grades of membership and qualifications therefor, and some recognition of the existence of other engineering centers than New York by "resident membership" provisions in regard to them also under certain conditions, the necessity is apparent for some such motion as we understand some western members propose to offer shortly for the appointment of a committee to revise and recodify the whole constitution. If the present contest, which certainly has its unpleasant features, shall emphasize the necessity of some such action, it will not have been in vain.

WE reproduce in this issue with cordial approval a brief paper by Mr. EMILE LOW on "Maps for Railway Surveys".

It outlines beyond question the best method of making railway maps, on loose sheets matched together by × × marks, and *not* on continuous rolls of paper or tracing cloth. If desired as a matter of record, continuous tracings may be made from these sheets as easily as from a rolled map, in fact much more easily: but for all working purposes, and for permanent preservation, the detached flat sheets are infinitely preferable. They fit in a small box, which is always the same size, and maps of thousands of miles of surveys may be stored away in a small pile of boxes. The sheets are always clean, and they are always flat and fit for work, if it be ten years after they were made; while their original construction is made greatly easier. Precisely the same arguments apply in favor of making all other large scale maps, as of cities or water-works, in the same way. In no case is anything lost, while as a rule much is gained. The large single scale maps are not only laborious to construct, but as a rule soon become entirely unserviceable from dust and "permanent set" in a curve.

The only exception we should take to the method outlined in Mr. Low's paper, is that it is questionable if it is worth taking much trouble to "orient" the sheets when a very crooked line is to be plotted. Certainly, no trouble at all should be taken to make the edges of the sheets precisely north and south. If they are nearly that, it is quite enough; and if, occasionally, an extra sheet can be saved by swinging one of them a little out of direction, it should be done. But with this exception and under these conditions, we believe it is advantageous on the whole to make a practice of orienting the sheets.

Locomotive Engine Resistance.

We reprint in another column an editorial from *The Engineer* continuing a discussion which has now run through several issues of that journal and of this, with some mutual profit, we trust, and in regard to which we can cordially echo its words that "like ourselves, our contemporary appears to be actuated by a desire to arrive at the truth, and not to achieve a barren dialectical success." Otherwise, such discussions are absolutely profitless, both to the reader who reads and the journal which publishes them. It is not likely that from the existing stock of information the absolute truth can be determined; but by a process of elimination a few fundamental facts can be determined, quite enough, we imagine, to indicate the general laws which govern train resistance with greater precision than has yet been done, or than was possible ten years ago, and if we mistake not, with some important practical morals therefrom.

Our contemporary is now, we think, well satisfied that our original contention was true, that at high speeds (say 55 miles per hour) something like 50 to 60 per cent. of the indicated horse-power of the locomotive is dissipated, somewhere and somehow, within the locomotive itself, and never goes back of the tender. There are contravening evidences like the test of MR. STROUDLEY before referred to, which showed little or no power consumed within the engine; but the sources of error can in that and most cases be explained without undue reflection on the technical competency of the observers, and the burden of evidence is overwhelmingly in favor of the position above stated. *The Engineer*, indeed, does not expressly admit that the percentage of high-speed engine resistance is as great as above stated, but it impliedly does so by endeavoring to explain how it may arise in a new way and by no where disputing it; and although it no doubt finds it, as we did, an embarrassing fact to admit for the reason that it is very difficult to explain how so great a dissipation of energy arises, yet we judge it to be a fact which must in candor be admitted by every one competent to weigh evidence when he comes to examine the evidence.

This we could properly claim at the date of our last article to which *The Engineer* replies; but since then we have had very strong confirmatory evidence in tests on the Chicago, Burlington & Quincy Railroad under the direction of Mr. GODFREY W. RHODES, Superintendent of Motive Power, recorded in full in our issues of Nov. 17, 28, 1888. We regret to observe that these tests have not been as yet published in England, as they are on the whole the most complete and satisfactory single series of tests on this subject known to us. The main facts of these tests, which all of our readers may not have fully in mind, were as follows:

It was indicated in the clearest manner that the per cent. of the engine resistance in the total resistance (See Table D, p. 410) was expressed approximately by the formula

$$\text{Per cent.} = 18 + .01\ v^2,$$

nearly, as an average between Mogul and American engines, 18 per cent. being consumed by the engine at slow speeds, and the amount increasing to 43 per cent. (exact average 43.2) at 50 miles per hour. This amount varied between a minimum of 30 and a maximum of 57 per cent. at 50 miles per hour, but at other speeds the fluctuation was less, and the main part of it seemed to be due to difference in the type of engine, the 6 driver Moguls showing much less proportion of engine resistance than the American. This was for a train weighing 492 tons, 77 tons of which was engine and tender. The evidence that the resistance of the cars only at 50 miles per hour was about 12 lbs. per ton in all winds and weathers except a side wind (when it was 4 or 5 lbs. per ton more) was if anything still clearer: and taking this in connection with the known fact that at low speeds the resistance of such cars is about 6 lbs. per ton, we obtained the two following tables, which will bear repetition, showing that the equation of total resistance per ton, engine and cars together, which is of the form $R = f\ v^2 + c$ and comes nearest to the observed facts is:

$$R = .006\ v^2 + 5.5$$

which is almost identical with D. K. CLARK'S original formula of

$$R = \frac{v^2}{171} + 8$$

when reduced to its equivalent for tons of 2,000 lbs., used throughout this article, viz.

$$R = .00552\ v^2 + 7.14$$

The degree of the agreement of both these formulæ with the results of the C. B. & Q. tests shown in Table E is shown in the accompanying Table F, and certainly is very close; thus going far to prove that the original tests on which D. K. CLARK's formula was based likewise showed engine resistance corresponding to those above stated.

TABLE E.—*Total Resistance of Passenger Trains, as indicated by the C. B. & Q. Tests.*

Vel. miles per hour.	Ratio of engine and car resistance to total as above.		Car resistance.	Total train resistance.		Eng. resistance only.	
	Eng. 77 tons.	Cars 325 tons.	T'tal. lbs.	T'tal lbs.	l. s. per ton.	T'tal. lbs.	lbs. per ton
10	19.	81.	6	1,950	2,410	6.00	460	6.0
20	22.	78.	8	2,000	3,550	8.28	730	9.5
30	27.	73.	10	3,250	4,450	11.05	1,200	15.6
40	34.	66.	12	3,900	5,900	14.66	2,000	26.0
50	43.	57.	14	4,550	7,980	19.80	3,430	44.5
60	54.	46.	16	5,200	11,320	28.10	6,120	79.4

TABLE F.—*Comparison of Total Train Resistance of Entire Train in lbs. per ton with that by Formulæ quoted.*

Speed m.p. h.	Compu'd lbs.p. ton as above	By formula $R = .006\ v^2 + 5.5$		By formula $R = .00552\ v^2 + 7.14$	
		lbs.p.ton	Error	lbs.p.ton	Error
10	6.00	6.1	+0.1	7.69	+1.69
20	8.28	7.9	−0.38	9.35	+1.07
30	11.05	10.9	−0.15	12.11	+1.06
40	14.66	15.1	+0.44	15.97	+1.31
50	19.80	20.5	+0.7	20.94	+1.14
60	28.10	27.1	−1.0	27.01	−1.09

When to this new evidence is added that which we have heretofore detailed, and on which alone *The Engineer's* discussion in another column is based, the case becomes almost unassailable that at these high speeds the proportion of engine resistance is something like that stated, and it remains to explain how it arises.

To explain these great aggregates of resistance *The Engineer* is driven to suggest an entirely new source of velocity resistance, in the following words; which we must confess we considered at first with great misgivings, as a rather startling innovation; but on further consideration we believe it is entitled to great weight. It at least serves to explain some very puzzling and anomalous facts, and we are forced to the conclusion that in its substance it is a true hypothesis:

"It seems to be clear that only one source of resistance remains unexplained, and that is the road. On a perfectly smooth, stiff, and level rail the rolling friction is extremely small, and it is quite possible our contemporary is approximately right in asserting that the resistance at the tail end of a train does not greatly augment with the speed. Let us consider, however, what the locomotive has to do. As the very best road is yielding, the engine has to continuously run up hill. It has to push down and consolidate the road for the vehicles following it, and it has been specially claimed for the bogie by American engineers that it is a "track setter". It will be readily understood that the rail has to be bent a little and pushed down into the sleeper, and the sleeper has to be pushed down into the ballast, and all represents work. The train has not this work to do, especially at high speeds, to anything like the same extent, because the rail has not time to spring up again after the passage of the engine. There is a certain analogy here between the action of a ship and a train. The bows of the ship have to push the water out of the way. The middle body follows without offering any resistance save skin friction. The locomotive does that vertically—in a sense—which a ship does horizontally in another sense, and the train fills the part of the middle body of the ship, and it is not impossible that as the rail rises behind the last vehicle, that may be said to be always running down, just as the locomotive is always running up hill, and its resistance will be proportionately diminished.

"This explanation must be taken for what it is worth, but we are unable to see where it fails. If it is true, then the difference between the total power exerted by the engine and that transmitted to the train will depend on the quality in respect to stiffness of the road, and this will explain why it is that vertical stiffness or resistance to deflection is a characteristic so highly prized by English railway engineers. It also follows that in all probability the road on which Mr. DUDLEY's experiments were made was a weak one, and consequently it must not be assumed that because the engines and tender used up 55.6 per cent. of the total indicated horse-power, that anything like this proportion must of necessity always be lost when the speed reaches 50 miles an hour. That a large proportion is expended we do not for a moment dispute. Concerning what our contemporary has written of Mr. STROUDLEY's paper, we may say that he seems to have misunderstood Mr. STROUDLEY, who speaks of the gross weight moved including the engine."

We must take issue with the last statement. Mr. STROUDLEY's paper showed by indicator tests the engine work and by dynamometer tests the work done behind the train which was almost exactly 100 per cent. of the indicated engine work. But the two records were taken on different days, and their entirely inadmissible indications are otherwise susceptible of partial explanation.

Likewise, it is unfortunate for *The Engineer's* theory that the road on which Mr. DUDLEY'S experiments were made, which it thinks was "in all probability a weak one", was the main line of the New York Central & Hudson River Railroad, a line unsurpassed either in traffic or superstructure by any line in England. Its track is not "sand-papered" as much as on some other lines nor perhaps as much as it ought to be, but in all the essentials it is exceedingly good. Nearly as much might be said for the track of the C. B. & Q. on which Mr. RHODES' tests were made. That part of this great system on which the tests were made has in all essentials first class track, probably considerably above the average of all England, although below the highest mark either there or here. It is a fact which our English friends do not always adequately realize that conditions are not exactly the same here as they were 20 years ago, and that, while we still have a good deal of poor track in our 158,000 miles, the best 20,000 of this is in all respects as good track as the best 20,000 in England, and a few hundred miles of it a shade better than any in England.

Again, while there is undoubtedly a yielding of the track under a train, which consumes power, there are strong apparent reasons why this should not increase with speed. It seems quite as plausible *a priori* that it should decrease with speed, for the reason that the track has less time to sink under the load, and so increase the depression from out of which the drivers and all succeeding wheels are continuously climbing; in like manner it is safer to skate over thin ice rapidly than slowly. It does not have time to sink dangerously.

Again, the parallel with the action of a ship's bows is open to certain evident objections. We know precisely why a steamer's resistance should increase very rapidly with speed. An immense mass of water is to be displaced at each side, not exactly by piling it up, but by imparting to it a considerable lateral velocity which will just suffice to relieve the hull amidships of pressure and enable the returning wave to strike the slanting stern and give back to it again most of the energy surrendered at the bow. The velocity thus communicated to the water must necessarily vary about as the speed of the vessel, to have the reflex wave strike the same part of the hull, and hence the energy communicated to give this velocity should properly vary about as the square of the speed. There being a certain waste in the process, which (with skin friction) represents the net work done, the propelling force in pounds might naturally be expected to vary nearly as the square of the speed, and hence the horse-power as the cube of the speed, which experiment shows to be the case.

But on a railway we have no such heavy masses to absorb a vast amount of energy by their inertia, and necessarily retain a part of it. There is nothing to be done except to press down a comparatively light and more or less elastic track to a solid bearing; and it is to be remembered that to the extent that it is elastic, an analogous aid is given to the motion of each wheel to that which a ship receives from the closing in of the waters about its tapering stern; and except for which, as *The Engineer* well points out, an enormous propulsive power would be demanded to obtain a very slow velocity. The track is certainly elastic, because it returns substantially to the same position from which it was depressed; and to the extent that it does so there is an elastic reaction behind the center of each wheel-bearing which tends to propel the wheel forward by approximately the same amount that the reaction in front tends to retard it. At very low velocities these two forces will approximately balance each other, tending to give a very low resistance even on yielding track, and this result, we know, actually obtains.

It has, however been acutely suggested in a discussion by Mr. DON J. WHITTEMORE before the American Society of Civil Engineers* that at the higher speeds this elastic compression is not equal on each side of the center of bearing, thus tending to nullify itself, but that there is a continuous wave of translation in front of the advancing wheel creating a very different elastic curve in front and behind, and tending to make the forward reaction much greater, and hence create a very considerable velocity resistance apart from air resistance. This hypothesis *The Engineer* now makes anew, and there is this strong fact in favor of its truth, which had not occurred to us until we began the preparation of this article, but which looks when fairly considered, like confirmation of a high character. The hypothesis not only explains high engine resistance at speed but explains certain anomalies in the gravity tests of rolling stock resistance made at Cleveland in 1878,† and which were then and still remain the only ones of their kind ever made except some German ones to which we will not refer in detail in this issue, except to say that they were even more in need of a similar explanation. Those tests were accurately made, by the aid of delicate electrical apparatus: the propelling force of gravity was known and constant, the resulting velocities were determined with minute exactness, and there were no other doubtful elements to cause error; they may therefore, we are confident, be assumed to be absolutely reliable, within a margin of error of about 0.1 lb. per ton, or say 1 to 5 per cent. They covered trains of 1, 2, 3 and 5 cars, loaded and empty, box and flat, all with a range in velocities of from 0 to 35 miles per hour. By comparison of the observed resistances with the various kinds of trains, it could be determined how much of the increase of resistance from velocity was due to air resistance, and how much to "oscillation and concussion" or some other like cause varying with weight and not bulk. For example, if a train of empty box cars was found to have a certain increase of velocity resistance, and the same train of box-cars, loaded a certain other rate of increase of velocity resistance, it was quite cer-

* Trans. Am. Soc. C. E. Dec, 1884, p. 448.

† Trans. Am. Soc. C. E, February, 1879.

tain that the difference was not due to a difference in air resistance, because there could be none, the exposed bulk and surface being the same, and the added load internal and screened from the air. If then (to repeat somewhat of what we have said before) the whole velocity resistance were from air, the total in pounds for the train would remain constant, and the total *in pounds per ton* be very much less. On the other hand, if the velocity resistance had nothing to do with air but came from "oscillation and concussion" or some other cause varying with weight and not bulk, we should expect the velocity resistance in *pounds per ton* to remain constant after loading the empty cars, and the total for the train to be increased *pro rata* with the weight. Finally, if the velocity resistance were partly from air and partly from some other cause, we should expect the velocity resistance to increase with weight but not in direct ratio, and the nearness with which it approached to direct ratio would indicate the relative importance of other causes than air resistance in the total velocity resistance. In like manner tests of box and flat cars and of trains of different length could be compared.

They were thus compared throughout, and the results were unmistakable and uniform in accordance with the last supposition. About *one-third* only of the increased resistance from velocity of an ordinary train was found to be traceable to air resistance, and the remaining *two-thirds* to some other cause which the maker of the tests (nor any who have discussed them) could not then or since explain, but which was assigned for lack of a better term to the vague cause "oscillation and concussion". It is obvious, however, that it is extremely difficult to explain how any large amount of resistance can come from this cause, while it is certainly not difficult to imagine that an unknown but very large increase of resistance might come from the piling up of an elastic wave, so to speak, in front of the wheels, at a steeper angle at high speeds. This cause, if it exists, would naturally vary with weight and not with bulk, and the hypothesis suffices to explain completely, therefore, the anomalous results of these tests, made only with comparatively light cars, as it does equally well the still more anomalous results of engine resistance tests, which show an aggregate impossible to explain by air resistance, as *The Engineer* well points out, yet seeming to certainly exist.

Nevertheless, it is as yet but an hypothesis, and in default of further evidence it must remain so; but it is an hypothesis with nothing about it repulsive to the reason, and which is supported by a large amount of independent evidence with all of which it agrees, and with none of which it is discordant. As respects any large velocity resistance from this cause, it is an entirely new hypothesis, and hence to be received with caution; but after having endeavored for ten years without success to form some other rational theory to explain observed facts which have lately been accumulating, and this doing so perfectly if admitted, we accept it *pro tem.* as the true one, and we congratulate *The Engineer* on having suggested it. It would obviously lead to certain important practical conclusions if admitted, and it demands further investigation.

Railways in Victoria.

The report of the Government railways in the colony of Victoria, Australia, for the year ending June 30, 1888, shows that there were opened during the year, 137 miles, against the same in 1887 and 67 in 1886. The total capital expended amounts to $141,060,000 on which the net revenue result is 3.56 per cent. The debenture capital amounts to $127,430,000, the debentures bearing from 4 to 6 per cent. interest. The high ratio of expenditure to receipts, 63.61 per cent., is caused by the new mileage running through undeveloped districts. The gross earnings per train mile amounted to $1.45 against $1.47 in 1887, and the expenses per train mile to 92 cts. against 84 cts. owing to extra compensation in the case of a serious accident.

The total revenue for all the systems was $13,780,245, an increase of $1,514,855; the total expenditure for all the systems was $8,765,095, an increase of $1,629,720. There were 1,947¼ miles of road open, and the train mileage was 9,082,312; the traffic included 55,911,394 passengers, 166,884 tons of live stock, and 3,397,158 tons of freight.

An Early East River Suspension Bridge.

In an odd number of the *Family Magazine*, now before us and published by the late PARK BENJAMIN in 1837, is a "Plan for a Suspension Bridge across East River, at Blackwell's Island, N. Y." The full-page engraving illustrating this structure shows three openings or spans of 700 ft. each, with the roadbed 120 ft. above high-water; and while the picture is a picture simply, without details, in its general appearance the design would do credit to any builders of the present day.

According to the text of the *Magazine* article, the designer of this structure was a Mr. R. GRAVES, and the following general dimensions are given:—Total distances from shore to shore across Blackwell's Island, 2108 ft., the bridge to have three spans of 700 ft. each between centers of end towers; the end towers to form abutments with arches; height of road-bed above high-water, 120 ft.; height to top of towers, 178 ft.; width of bridge, 45 ft.

The suspension members for each span were to be four lines of "malleable iron chains or cables", from which the floor-system was to be suspended by iron rods; and on each side of the floor, and extending above and below it, were deep iron lattice trusses. Mr. GRAVES estimated that this bridge could safely sustain a distributed load of 1200 tons; and that it would cost "somewhere between" $500,000 and $800,000 to build it.

We do not now know who this Mr. GRAVES was, but as he evidently contemplated the use of wire cables and had the Fribourg bridge (erected 1831-4) as a precedent, his project is an interesting item in the history of suspension bridges in the United States. This plan antedates CHARLES ELLET'S suspension bridges, at Wheeling, Niagara and Philadelphia, by at least 10 years; and the ROEBLING railway bridge at Niagara, the first really important suspension bridge in this country, was not built until 1854.

CORRESPONDENCE.

Excessive Rainfalls.

NORWICH, Conn., Dec. 28, 1888.

EDITOR ENGINEERING NEWS:

In volume 19, page 47, appears an interesting letter from the Chief Signal Officer, with extract from Nov. (1887) weather review on the subject of excessive rainfalls. The table therein given is not in all respects plain to me. The "rate per hour" in 12 cases seems to be the amount which fell in one hour, presumably in the heaviest part of the storm. In the remaining four cases it is made up proportionally from the amount falling in a much shorter time, presumably the full length of the shower.

The "maximum rate at any time" is given in five cases the same as the "rate per hour," indicating, either that the rate was uniform for the whole time (in one case a full hour), or else that no note was taken of intermediate rates. In all the other cases the maximum rate is given as greater than the rate per hour, which one would naturally expect to always be the case.

It does not appear what minimum time was taken in fixing the maximum rate. For instance $\frac{25}{100}$ of an inch of rain falling in 6 minutes, if none fell in the preceding nor succeeding nine minutes, would have little, if any, greater effect on a sewer, than if it had been 15 minutes in falling, in which latter case the maximum rate would have been 3.80 instead of 9.00.

It is assumed that rates of less than 1-in. per hour are not especially important, which would seem to be the case so far as sewers which carry all the storm-water are concerned.

In cases when the sewage, and a small portion only of the storm-water, is carried to a distant outlet, the remaining storm-water being discharged through overflow channels into waters which should receive only a nominal amount of sewage, the frequency of smaller storms becomes of importance.

If sewers are arranged to overflow when the rainfall exceeds a certain rate, say ¼ or ⅓ inch per hour, it becomes important to know approximately how often the overflows are likely to be called into use, as the waters at their outlets will not be as likely to be made offensive by an occasional, as by a frequent, overflow.

I think further information on these points would be of general interest. Yours respectfully,

C. E. CHANDLER.

An Effective Stop-Valve.

CAMBRIDGE, N. Y., Dec. 29, 1888.

EDITOR ENGINEERING NEWS:

Saturday, December 22, a terrific explosion occurred in Brown's Hotel at Eagle Bridge, N. Y., which wrecked the lower part of the building and injured eight persons, at least one of them fatally.

I passed through Eagle Bridge on the 24th inst. and saw the wreck, and have inquired into the cause of the explosion. The building was warmed by a Henderson hot water heater which had only been in operation about two weeks. The expansion tank only held about one gallon, and when the heater was running the tank would fill whenever the fire got very hot and would run over. To avoid this, instead of putting in a larger expansion tank, a STOP VALVE *was placed on the pipe leading to the expansion tank.* The consequence was that when a hotter fire than usual was built on the 22nd, it was a very cold day, there being no chance for expansion of the contents of the pipes, the heater exploded with the results mentioned.

Putting in a stop valve and thus shutting off the expansion tank was similar to tying down the safety valve on a boiler, and of course gave similar results.

This would not condemn the Henderson heater, as it should work with only the pressure due to the head of water in the pipes. The man who put in the stop valve is at fault. Yours truly,

W. C. HAWLEY.

Lowry Pumps.—Correction.

Norfolk & Western R. R.
TAZEWELL, Va., Dec. 19, 1888.

EDITOR ENGINEERING NEWS:

Referring to your Table 16-B on page 473 of last issue, I see you only ascribe one Lowry pump to Pennsylvania. To my certain knowledge there are 6 pumps of that kind alone in the city of Pittsburg, 4 at the *New* water-works each of a capacity of 20,000,000 galls., 1 at the old works, perhaps now abandoned, and 1 (at least) on the south side; Monongahela Water Co. There is also 1 in operation at the Allegheny City, Pa., water-works of 15,000,000 galls. capacity, I think. Yours truly, EMILE LOW.

[The pumps mentioned by our correspondent were included among the "Miscellaneous", the kind not having been reported to us; but with only 50,000,000 instead of 80,000,000 capacity. The table should be corrected accordingly. ED. ENG. NEWS.]

The Proposed Passaic Water Supply.

BROOKLYN, N. Y., Dec. 23, 1888.

EDITOR ENGINEERING NEWS:

Referring to an article in your journal of Dec. 22 on the proposed Passaic water supply for the lower part of New York, permit me to make a few remarks.

While there can be no obstacles in an engineering point of view to the project, and the favorable opinion of such legal advisers as Messrs CLARENCE SEWARD and ROSCOE CONKLING would seem to imply that no legal obstacles need be anticipated; yet if such be the fact, I doubt not that there are many engineers, who, like myself have been in ignorance of what constitutes riparian rights on water courses, and would like to hear something from the NEWS on that point.

Setting aside for the present any consideration of the adequacy or otherwise of the Croton basin for the water supply of New York City, I would call your attention to the single proposition of Mr. BARTLETT to deliver 50,000,000 galls. daily from the Passaic basin into this city, omitting all question of the time necessary to complete a tunnel under the North River, or the complication growing out of the increased pressure put upon the pipes in the city, of which I shall take occasion to comment in a future article.

Mr. BARTLETT states that all legal difficulties have been surmounted through negotiations perfected with the Society for Establishing Useful Manufactures, of Paterson, N. J., and the Dundee Water Power & Land Co., of Passaic, by which "exclusive control of all the surplus water of the Passaic has been obtained for all time to come". The first question which arises is: What is surplus water, and who or what authority shall determine its amount?

In October, 1880, the flow of the Passaic at Paterson was as low as 90,000,000 galls. per day as stated by Mr.

CROES, and Dec. 12 a freshet occurred which could not be measured at Paterson, but at Dundee measured 11,579,000,000 galls. Between these two limits what shall be considered as "surplus" water, and who shall determine it?

In 1883, the increasing demand for water for domestic and manufacturing uses in New Jersey, led to the appointment of a Commission, to examine and report upon the water resources of the State; to determine upon the best plans for supplying cities, towns and other municipalities in the State; to ascertain and determine the best method of storing the same; also the sources of supply, having respect to the future growth of the population; and also gave them "authority to proceed by law against any person diminishing the amount of water that would naturally flow into the State"; and providing the funds for the prosecution of the same. This Commission reported in 1884, and is, as I am told, still in existence; if not, the recognized value of their labors would insure the revival of the Commission. The kingdom of Würtemburg, instituted such a "collective" system, as it is called, by which the water supply for all purposes in a State as large as Massachusetts, is under a single control, and with very happy results.

Again, Mr. BARTLETT claims to have purchased the right of the Manufacturing Society of Paterson, to abstract from the legitimate demands of the residents on the Passaic valley, and deliver without the limits of the State, daily, a quantity of water, which as we have seen, exceeds half of a known daily supply of the entire valley in a dry season. It scarcely admits of question, that before the State of New Jersey will permit half of the daily low summer flow of water from the Passaic basin of 900 sq. miles to be abstracted from her increasing population, and enormously valuable and increasing manufactures, and sold to consumers beyond the limits of the State, she will seek every legal power of redress obtainable from the highest tribunal of the land. The right of "eminent domain", if applicable to State legislative control over the streams within the State, extends no further than to control the *use* of the water within the State. What the terms of the charter of this Society granted in 1791 are, I cannot say;

The Legislature can seize, so to speak, both land and water from individual owners for *public* benefit, paying for the same, but cannot alienate the vested rights of one individual for the benefit of another, or confer upon a private corporation such powers; and while perhaps the riparian rights of individuals in the waters of the State, may not have been determined by statute law, there is an unwritten law, which I am inclined to think will prove a bar to any such project as that of Mr. BARTLETT'S, to sell without the bounds of the State, water, which the people of the State may claim to have enjoyed exclusively from time immemorial.

If I am wrong in this view of the case, I should like to be set right. J. W. ADAMS.

[As we understand it the Legislature of a State, it being sovereign within the limits of the National Constitution, can either assume itself or confer upon any city, town, corporation or person whatever, the right to condemn by appraisement any property of any other person for a use alleged to be for the public good, under the right of eminent domain; and the propriety of the act cannot be questioned in the courts, except on the ground that the property is for a use which is not *in its nature* for the public good. The Legislature is the sole and final judge as to the merits of a particular case, and the courts will not question their wisdom, but only whether the alleged purpose comes within the scope of the right of eminent domain. That the Legislature can forbid the expropriation of a water supply for the use of another State on the ground that it is needed at home, we take to be beyond question, but that it can likewise authorize its condemnation for use in another State seems equally clear. Suppose the Passaic supply were the only one available for New York, could New Jersey play dog in the manger, and neither use the water itself nor permit others to do so? A claim that the supply was no more than sufficient for home necessities puts the matter on a different basis. The right of eminent domain, moreover, is one transferable to any person or corporation proposing to fulfill a public need, and every railway so far built has enjoyed it, although only two or three have been built by the public.—ED. ENG. NEWS].

The Flow of Water in Pipes; a Correction.

BOSTON, Dec. 19, 1888.

EDITOR ENGINEERING NEWS:—

In the Transactions of the American Society of Civil Engineers, published September, 1888, containing paper No. 395, entitled "Some facts in Relation to Friction, Waste and Loss of Water in Mains" by CHAS. B. BRUSH, together with discussion on the same by various parties, including L. L. TRIBUS, both Mr. Brush and Mr. TRIBUS give credit to certain tables, relating to the flow of water, to the Cincinnati & Newport Pipe Co., now succeeded by the Addyston Pipe & Steel Co., of Cincinnati, O. As these tables were originally prepared by Mr. ELLIS and myself, copyrighted and gratuitously distributed to the profession, and especially to the American Water-Works Association at their meeting held at Buffalo, May 16, 1883, as accompanying and supplementary to a paper on the "Flow of Water" read by Mr. ELLIS at that time, we were a little surprised that credit should be given to the Cincinnati & Newport Pipe Co., instead of to ourselves for these tables. We, therefore, wrote Mr. BRUSH in relation to the matter and beg leave to submit his reply as given below.

Yours Respectfully,
HOWLAND & ELLIS, C. E.,
No 71 Equitable Building, Boston.

HOBOKEN, N. J. Dec. 18, 1888.

HOWLAND & ELLIS,
71 Equitable Building, Boston, Mass

DEAR SIRS:—I have your letter of the 17, inst. I certainly did not know that the tables published by the Cincinnati & Newport Pipe Co., were those originally published and copyrighted by you. I failed to give you proper credit for the tables in my paper simply because I was unable to determine their authorship from anything contained in the catalogue of the Pipe Co., I therefore naturally gave the company credit for the tables.

Yours Respectfully,
(Signed) CHAS. B. BRUSH.

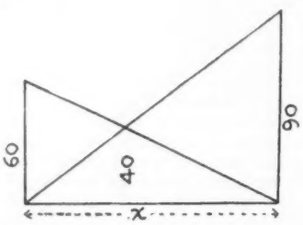
A Simple Nut to Crack.

CINCINNATI, O., Dec. 23, 1888.

EDITOR ENGINEERING NEWS:

The following "Nut to Crack" has been presented to me for elucidation and as a pastime in this season of turkey stuffed with oysters, I present it to you.

What is the distance between these perpendiculars: One line is 90 ft. and the other 60 ft. and lines drawn from the bottom of each to the top of the other cross 40 ft. above the horizontal?



The solution of the problem appears easy as the condition seem to indicate only one answer, The real solution is "why"? and I have not found the specified answer yet.

Hoping you may find pleasure and profit in the study of it and enjoy the nervine of your holiday celery.

I am as ever, yours DAVID.

[To save the brains of our readers too much wear and tear we suggest that the answer is: any base x which $= \frac{8}{9}x$ will satisfy the problem, and no other. —ED. ENG. NEWS.]

Cement vs. Vitrified Pipe.

ST. LOUIS, Dec. 27, 1888.

EDITOR ENGINEERING NEWS:

In your issue of Dec. 22, appears a letter from the Wilson & Baillie Mfg. Co. advocating the merits of cement pipe as superior to vitrified pipe. We do not care to take up your valuable space with our comments on the letter or its subject, but would be glad if you would find room in your columns for the matter composing the enclosed circular letter. We did not think that at the present time there existed any doubt of the general superiority of vitrified pipe, its almost universal use throughout the civilized world being good evidence of that conclusion.

Yours truly, BLACKMER & POST.

[As the matter referred to was published in full in our journal of 1874, it is only necessary to mention here that it includes testimonials of the highest order from the City Engineers of Philadelphia, Baltimore, Minneapolis, Hartford, Boston, Jersey City, Newark, Cincinnati, Chicago, Washington and a number of other cities; all of which are most decidedly in favor of the vitrified pipe as superior to cement pipe tested by them. The only saving clause in this wholesale condemnation of cement as a material is the fact that it was based on the methods of manufacture of about 15 years ago.—ED. ENG. NEWS.]

The Opposition Ticket for President of the Am. Soc. C. E.

CHICAGO, Ill., Dec. 31, 1888.

EDITOR ENGINEERING NEWS:

It is much to be deplored that the next election of a President of the Am. Soc. C. E. is to be made the occasion of personal gratification by the presentation of another name in the eleventh hour. The regular Nomination Committee of the Society, nominated for President, Mr. MAX. J. BECKER, Chief Engineer of the Pittsburg, Cincinnati & St. Louis R. R., an eminent and old engineer of the highest character, both professionally and socially, and holding a high position similar to the one held by one of our Ex-Presidents, Mr. DON J. WHITTEMORE. Mr. BECKER, as is well known, accepted the nomination only after he was distinctly assured of its unanimity by the Committee. Personally, I know he did not seek or expect the honor.

It has become understood in the Society that the position of President is a mark of honor to be bestowed as a rule only on older and distinguished members, and the usual short duration of the office makes it possible to reach successively nearly all those deserving the honor. The election after the nomination by the Nominating Committee is understood to be a mere matter of form.

The duties are not so arduous that they cannot be fulfilled by a President living at a distance from New York, and there was no objection heretofore to selecting candidates from a distance, if deemed deserving of the honor. Do all the distinguished engineers live in or near New York? No one would claim that much I trust.

The presentation of the name of Mr. T. C. CLARKE of New York for the presidency of our Society, with the rest of the ticket unchanged, and at the last moment, is a somewhat remarkable proceeding, particularly as it is not endorsed by the signatures of any committee or otherwise, and it does not appear who is responsible for this electioneering manœuvre. Inference may easily be drawn which I do not care to specify. Mr. CLARKE is a very estimable and well known gentleman and a shrewd business man, to whom the honor may not be without some business value; while such an aspect of the candidacy is entirely absent in a man in Mr. BECKER'S responsible position, trusted and honored by his company and beloved by his subordinates. At least so the matter must appear to most of those having the pleasure of personally knowing both the candidates.

For the good and dignity of the Society it would be well if such rivalries, particularly those thrust on the members at the last moment, could be avoided, and a change in the mode of nominating and electing our president seems highly desirable to that end, though it may not be easy to say precisely what the change should be.

A MEMBER
of the Am. Soc. C. E.

Rand vs. Sergeant Rock Drills.

NEW YORK, Dec. 29, 1888.

EDITOR ENGINEERING NEWS:—

In your issue of to-day we observe a letter addressed by our aggressive friends, the Rand Drill Company, in which, under the caption "Comparative Tests of Rock Drills" they present a table giving the results in detail of a power drill test at Ludington Mine.

In the first place, permit us to say in answer to your editorial comments, that we will assume that the test was thoroughly made, that the air supply was accurately measured, and that the figures given in the table are true; but we must protest against the inference which might be drawn, and which your correspondent evidently intends that your readers *should* draw from his figures. By an analysis of the table, we are brought for results to the last column, in which the consumption of air per inch of hole drilled is given for the "Rand" and the "Sergeant" drills respectively, under two conditions, one where the drills are mounted on columns, and the other on tripods. Now our aggressive friends evidently desire that your readers should see very clearly that in both of these tests the "Rand" drill was bigger than the "Sergeant", and that the unthinking reader should hold up his hands in amazement that, so many claims have been made for the "Sergeant", when a *big* "Rand", drill consumes *less* air per inch of hole drilled than a *little* "Sergeant"! Is it fair to make a comparative test of the consumption of air *per inch of hole drilled*, between two drills, one of which has a larger diameter, hence a greater area of pressure; and a heavier piston, hence a greater momentum and force of blow than the other? On the contrary, can anyone dispute the claim that when boring "Hard Granite Boulders", a strong blow is required in order to make progress, and does anyone question the fact that a big machine will hit a harder blow than a little one? Can we not easily imagine a small drill pegging away at a hard granite boulder and consuming several hundred cubic feet of free air per minute without progressing a *single inch*, while a large drill of precisely the same construction would make considerable progress with an equal consumption of air. A man might drive a

railroad spike with a tack hammer, and expend a good deal more breath in the operation than with a sledge.

It seems to us that the figures prove two things very clearly. In the first place, that a big drill will consume less air than a little one per inch of hole of same diameter drilled, when operating in hard material (A fact well understood heretofore). And in the second place, that a "Rand" drill takes more than twice as much air per inch drilled, when working horizontally as when working vertically or downward (due to the cushioned blow—a distinctive defect in the "Little Giant",) while with the "Sergeant" the proportion is very much more uniform. These facts furthermore prove that a test on the consumption of air per inch of hole drilled between drills of different sizes, has no practical value.

INGERSOLL ROCK DRILL CO. W. L. S.

[The Rand Drill Co. also send an answer to our foot-note to the following purport: That the first news the Rand Drill had of the test being made was a letter from the superintendent of the Chapin Mining Co. stating the fact, and enclosing the report given last week. A later letter from the superintendent says—that:

"This test was made on the Ludington Location. It was not the intention at first to make a test of the drills, but simply to ascertain the consumption of air used by the machines, the Ludington people having an independent pair of compressors. The Rand drill was one of the last lot purchased from you, and it was in good condition. The Sergeant drill has not been in use a very long time. I say this from the fact that it is not many months ago that the Ludington people purchased it. The Ludington mine had one of the "Little Giants", same size as the Sergeant which we proposed to put into the contest, but found upon examination it was in such bad order that we thought it hardly just to the builder to enter it, and so we were compelled to use a larger Rand in the work. We think the conditions of this test a very good one, as full memoranda were taken."

These two mines ran all their machinery with compressed air developed by a large plant of 32×60 in. and 36×60 in. duplex compressors of Rand make, located 3 miles away from the mines.—ED. ENG. NEWS.]

New York City Water Supply.

NEW YORK, Dec. 24, 1888.

EDITOR ENGINEERING NEWS

In your last issue I notice your very valuable remarks on the proposition of the Bartlett syndicate to supply New York City with water, I enclose a copy of a communication on the same subject submitted by myself to the Board of Sinking Fund Commissioners on the same subject, which I presume you have overlooked, also a blue print showing the location of plant and line of pipe to the head waters of the Croton river.

I also send you a pamphlet explaining my proposition for supplying an efficient fire service, taking the water from the North or East Rivers as suggested in your remarks,

If you there is anything in them that would be interesting to your readers you can make what use of them you may see fit. In my estimate of cost of pumping I figured on 100,000,000 ft. lbs. duty.

Yours truly, JOHN LOCKWOOD.

[Mr. LOCKWOOD's proposition is in brief this: To place a pumping station just above Poughkeepsie, lift the water some 300 ft. high, and then lay a 60 in. pipe 15 miles in length, delivering the water from the pipe into the head waters of the Croton at the divide, just north of "Black Pond" where the elevation above tide is about 150 ft. This water would find its way into Boyd's, and other reservoirs in the vicinity, flowing some 30 miles in the natural Croton water courses before entering the aqueduct.

The cost for a 50 million gallon daily supply is estimated as follows, assuming that a 60 in. pipe which will deliver about 75 million gallons per diem under a head of 150 ft.

15 miles 60 in. Cast-Iron Pipe laid complete	$1,740,000
Pumping Station complete	650,000
Add 10% for Engineering, etc.	239,000
Total Cost	$2,629,000
RUNNING EXPENSES.	
Pumping 50,000,000 galls. per annum 300 ft. high at $10.00 per day	182,500
Interest on Plant at 3 per cent.	78,870
Total annual cost of 50,000,000 galls	$261,870
Against cost per year of proposed Passaic supply 50,000,000 galls., at $75.00 per day	$1,368,750
$261,870.00 capitalized at 3 per cent	$8,729,000
$1,368,750 capitalized at 3 per cent	$45,625,000

If new high pressure mains are added, the cost is put at $10,500,000, increasing the capitalized cost of the supply to $56,125,000. The cost of pumping is estimated as approximately 80 per cent. cheaper than the proposed supply from New Jersey.—ED. ENG. NEWS.]

Experiments on Crushing Strength as affected by Area Subjected to Pressure.

University of Illinois.
CHAMPAIGN, Ill., Dec. 15, 1888.

EDITOR ENGINEERING NEWS:

A few months ago there was some discussion in the columns of your journal as to the relative crushing strength when the pressure was applied (1) uniformly over the entire upper surface and (2) to only a relatively small part of that surface, I have recently completed the experiments as below, and offer them as an experimental demonstration of the amount of what everybody believed must be true in some degree. So far as I know these are the only experiments on this subject.

Reference No.	Material.	Thickness of Block.	Center of Die from edge.	No. of Tri'ls	Load per sq.in. concentrated pressure	Effect of the Concentrated Pressure.	no. of trials	Cr'shing strength per sq.in. Distributed pressure	Ratio.
1	Lime mortar	½ in.	2 in.	4	3,610	crushed	3	1,340	2.7
2	Lime mortar adhering to brick	¾ "	"	1	16,245	"	1	1,200	
3	Marble	1 in.	"	1	10,850	mark just visible	3	10,500	
4	"	"	"	1	14,440	indentati'n just perc'ptible		"	
5	"	"	"	4	18,050	crushed		"	1.7
6	"	2 "	"	3	36,100	"	3	10,100	3.6
7	Brick	2¼ in.	"	2	3,542	"	2	1,590	2.8
8	"	"	"	2	2,745	"	2	1,010	2.7
9	"	"	"	1	13,790	"	3	3,651	3.7
10	"	"	"	3	31,730	"	3	6,190	5.0
11	"	"	"	3	7,200	"	3	830	8.0
12	Meyenberg brick	"	"	1	87,362	"			
13	Limestone	3 in.	"	4	31,046	"	3	3,453	9.0
14	Sandstone	"	"	2	51,600	"	3	3,606	14.0
15	Limestone	4 in.	"	3	75,361	"	2	4,671	16.0
16	"	7 "	"	2	64,077	"	5	3,453	18.5
14	Sandstone	3 in.	2 in.	2	51,600	crushed	3	3,606	14.0
17	"	"	3 "	1	59,204	"		"	16.0
18	"	"	4 "	1	75,810	"		"	20.5
15	Limestone	4 in.	2 in.	3	75,361	crushed	2	4,671	16.
19	"	"	3 "	3	102,900	"		"	22.
20	"	"	4 "	1	111,188	"		"	24.
16	Limestone	7 in.	2 in	2	64,077	crushed	5	3,453	18.5
21	"	"	4 "	1	87,720	"		"	25.
22	Iron Bar 1 inch square, 4 long	1 in.	¼ in.	1	43,320	mark barely visible			
23	" " "	"	"	1	64,980				
24	" " "	"	"	1	100,250	" 0.01 inch deep			

28 Clay, which for years has safely carried, without appreciable settlement, buildings concentrating 1½ to 2 tons per square foot (30 to 28 pounds per square inch), when tested in the form of cubes, was crushed with 4 to 8 pounds per square inch. In this case the average "ratio" is 4.3.

The ordinary "crushing strength" was obtained by crushing cubes of the identical materials employed in the other experiments. The concentrated pressure was applied by means of a hardened steel die 38-64 in. in diameter (area a = 0.277 sq. in.) All the tests were made between self-adjusting parallel plates of a hydrostatic testing machine belonging to the University of Illinois. No packing was used in either series of experiments; that is to say, the pressed surfaces were the same in both series. However the block of limestone 7 ins. thick (Experiments Nos. 16 and 21) is an exception in this respect. It had been sawed out, and was slightly hollow; and it was thought not to be worth while to dress it down to a plane. As predicted before making the test, the block split each time in the direction of the hollow. If the bed had been flat, the block would doubtless have shown a greater strength. The concentrated pressure was generally applied near the corner of a large block, and hence the distance from the center of the die to the edge of the block is to the nearest edge. Frequently the block had a ragged edge, and therefore these distances are only approximate. The quantity in the last column of the table—"Ratio"—is the crushing load per square inch for concentrated pressures *divided by* the crushing load per square inch for uniform pressure.

These experiments were carried on incidentally with another series, and not especially to obtain the results herewith submitted; otherwise an attempt would have been made to make them more complete in some particulars. The experiments are tabulated in an order intended to show that the strength under concentrated pressures varies (1) with the thickness of the block, and (2) with the distance between the die and the edge of the material being tested.

Certain conclusions that might appropriately be drawn from the above table have already been considered in your columns, and hence need not be repeated here.

IRA O. BAKER.

PUBLICATIONS RECEIVED.

Car Truck and Track Equipment.—Wheels, Brake-shoes, Packing-rings, Journal Boxes, Safety Switches and Stands, Frogs, Crossings and Signals. Ramapo Wheel & Foundry Co., Ramapo, N. Y.; and Ramapo Iron Works, Hilburn, N. Y.

Although a strictly trade publication, prepared as a catalogue of the output of two allied concerns, this handsome publication is full of useful technical matter, much of it among the latest. As a specimen of the printer's art it is not surpassed by any that we know of, nor was it likely to be, coming from the De Vinne press. The publication is likewise most acceptably different from many such publications in this respect: it contains hardly a word or a cut but what is likely to be useful for the absolute conveyance of information. There are no display lines of big type; no pages of wearisome certificates of merit: no pictures plastered all over with big lettering. The cuts are mostly working drawings to scale with dimensions given, or heliographic views of the things illustrated in use. The text is strictly confined to what is necessary for the conveyance of definite facts in ordinary type, and beyond this the merits and demerits of the articles shown are left to speak for themselves. If manufacturers only appreciated how much more effective such a style of publication is, merely as an immediate advertisement, and how much more likely the publication is to be preserved and used, they would never adopt any other. One of the most interesting features of this catalogue are the illustrations of single and double slip switches, or cross switches, as they are getting to be called in this country, a track detail in which our practice is still somewhat backward, and which is certain to come into more general use.

Geological Survey of New Jersey.—Final Report of the State Geologist. Vol. I. Topography, Magnetism, Climate, Trenton, 1888.

Mr. GEORGE H. COOK, the State Geologist, and all concerned with him, are to be congratulated; not only on the near completion of their labors, but also upon the admirable methods by which this survey has been conducted and the artistic manner in which the results have been recorded on the maps so far issued. This first volume of the final report is devoted to the subjects mentioned in the title. The physical description of the State, by Mr. C. C. VERMEULE, is particularly interesting, dealing as it does with the earliest boundary controversies and decisions and introducing much documentary history and a fac-simile map of this region of about 1650. The record of political sub-divisions of the State is also a valuable historical and statistical feature. The topography is exhaustively treated and this portion of the work is illustrated by a superb relief map, showing the elevations by gradations of tint. In this section is a tabular statement of the areas of water-sheds of the various streams, with percentage of forest and population per square mile. What a boon it would be to hydraulic engineers if every State was as conscientiously mapped out in this particular? The Magnetic Survey and the article on the Climatology of New Jersey are both valuable and interesting, but space forbids any adequate treatment of them in this place.

Journal of the Association of Engineering Societies. December, 1888, 30 cts.—This number contains the following papers: "The Dam of the Cambridge (Mass.) Water-Works on Stoney Brook," (illustrated), WILLIAM S. BARBOUR; "Percolation through Embankments," (illustrated), JOHN R. FREEMAN; "Lawrence (Mass.) Dam across Merrimack River," (illustrated), with discussion RICHARD A. HALE; "A Brief Description of the Quincy Dam, at Braintree, Mass.," LUCIAN A. TAYLOR.

Elements of Machine Design.—Notes and Plates. For the use of Students in Lehigh University. By J. F. KLEIN,

Professor of Mechanical Engineering. Bethlehem, Pa., 1889.

This is a limited edition of a work intended to aid students in this branch of engineering, and is supposed to be used in conjunction with the more complete treatises of REULEAUX and UNWIN. The text is concise but plain; the illustrations carefully selected and well drawn, and numerous tables are inserted to lessen the work of calculation, including new tables for finding speed cone diameters and laying out the profile of teeth by rectangular co-ordinates.

PERSONAL.

EX-GOV. L. F. HUBBARD has been appointed General Manager of the Duluth, Red Wing & Southern Ry. Co.

Mr. J. G. METCALF, Superintendent of the North & South Alabama Division of the Louisville & Nashville, has been appointed General Manager, vice Mr. J. T. HARAHAN resigned.

Mr. ARTHUR JOHNSON, Mechanical Engineer of the New York, Lake Erie & Western Ry., has resigned his position. He had been at the Jersey City shops for 25 years.

Mr. C. H. TAYLOR, recently Superintendent of Water-Works at Merrill, Wis., has been transferred to the same office at Kokomo, Ind., where he may henceforth be addressed.

Mr. WM. B. DODDRIDGE, Superintendent of the Missouri Pacific Ry. in Kansas and Nebraska, has resigned to accept the appointment of General Manager of the St. Louis, Arkansas & Texas Ry., vice Mr. W. P. HOMAN resigned. He will be succeeded by Mr. C. M. RATHBUN.

Mr. D. H. NEALE, for several years past engineering editor of the *Railroad Gazette*, has closed his connection with that journal, and has been appointed by the Commissioner of Railways in New South Wales to an important position in the superintendence of the locomotive department of the Government railways in that colony. Mr. NEALE is not only a thoroughly sound locomotive engineer, and an able writer, but has held important positions on the Great Eastern and Great Western railways, in England, and at the Cape of Good Hope, while his five years' residence in this country will no doubt likewise help to render him a valuable acquisition to the Government of New South Wales.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—An opposition ticket for officers, the same in all respects as the regular ticket, but with the name of Mr. THOS. C. CLARKE, of New York, substituted for that of Mr. MAX. J. BECKER, of Pittsburg, was issued to members, anonymously, shortly after sending out the regular ballots. The following circular has been issued in regard to it, headed "Irregular Ticket for Officers of the American Society of Civil Engineers":

Inasmuch as an opposition ticket has been sent out by unknown persons, in which the nominee of the regular ticket for President is ignored, we submit the following remarks concerning the regular ticket:

The Nominating Committee was appointed at the Milwaukee Convention, with a special view to nominate a ticket that would represent all sections of the country. The Committee met in the city of New York, and after a full and free discussion, unanimously nominated the ticket, which has been regularly issued by the Board of Directors, bearing the name of MAX. J. BECKER thereon for President. Under the pretext that he is not an American-born citizen, it has been undertaken to defeat his election by sending out an irregular ticket, having thereon all the names that are on the regular ticket, except that of Mr. BECKER.

Mr. BECKER is an eminent and successful engineer of the highest standing, socially and professionally, well qualified to perform the duties of President of the Society, and having been nominated by the duly appointed Committee, should receive the suffrages of the members, unless there is some good reason for withholding them.

The undersigned members, feeling very strongly that a great injustice is being attempted, as also an injury to the Society, unite in requesting you to vote the regular ticket.

CHAS. PAINE, Past President,
WM. METCALF,
E. B. TAYLOR,
JOS. WOOD,
ALEX. DEMPSTER,
THOS. RODD,
CHAS. DAVIS,
GEO. H. BROWNE,
A. GOTTLIEB,
CHAS. R. JOHNSTON,
JESSE W. WALKER,
CHAS. E. BILLIN,
ALFRED E. HUNT,
HENRY G. MORSE,
F. C. DORAN,
L. F. LOREE,
REUBEN MILLER.

At the regular meeting on Jan. 2, Vice-President J. J. R CROES in the chair and a number of members present, a number of discussions of the papers of Mr. JAS. B. FRANCIS and Mr. JAS. D. SCHUYLER on Strains in Masonry Dams were read and discussed. A considerable portion of the discussion was upon the merits of a curved or straight plan for the Quaker Bridge dam, without bringing out any technical points of especial interest. The following candidates were elected:

Members.

WINTHROP BARTLETT, Olive St. cable line, St. Louis, Mo.
CHARLES ADDISON FERRY, First Asst. City Eng., New Haven, Conn.
JOHN LELAND FITZGERALD, Schenectady, N. Y.
CHAS. WINGATE GIBBS, Chf. Eng., Silverton Ry., Silverton, Col.
ED. ADINO HANDY, Div. Eng., L. S. & M. S. Ry., Cleveland, O.
GEO. ALEX. KEEFER, Chf. Eng., Vancouver Water-Works, Victoria, B. C.
JAS. WARREN PEARL, Asst. Eng., Wrought Iron Bridge Co., Canton, O.
JOHN CHAS. QUINTUS, U. S. Inspector in charge of Piers, etc. Erie, Pa.
LEWIS FRED'K. RICE, Boston, Mass.
WM. BENSON STOREY, Southern Pacific Ry., Carbonado, Wash. Ty.
WM. HENRY WENTWORTH, Monterey & Gulf of Mexico Ry., Monterey, Mex.

Associate.

JOHN ELFRETH WATKINS, U. S. National Museum, Washington, D. C.

Juniors.

YSIDORI YGNACIO POLLEDO, Cardenas & Jucaro Ry., Cardenas, Cuba.
CHAS. ST. JOHN WARNER, New York City.

Engineers Club of Philadelphia.—Record of regular meeting, Dec. 15th, 1888; Vice-President JOHN T. BOYD in the chair, 31 members present. The Secretary presented, for Mr. J. MILTON TITLOW, some historical particulars with regard to the old Market Street Bridge, Philadelphia, with an electrotype of the copper plate found at low water level in the middle of the east pier, when it was taken down to be rebuilt above low water for the present iron cantilever bridge. Mr. F. J. AMWEG exhibited photographs of the piers when the rebuilding was being started, and gave some account of the substantial character of the old work, etc.

Mr. ARTHUR MARICHAL presented—as a discussion of Prof. L. M. HAUPT's recent paper on the plans for the proposed improvement of the bar at the entrance to the Rio Grande do Sul, Brazil—a description of the improvements of the harbor of Libau, Russia.

Prof. H. W. SPANGLER, Mr. ARTHUR MARICHAL and the author, Mr. J. E. CODMAN, continued the discussion of "Indicator Cards from Compound Engines, Showing Expansion through High and Low Pressure Cylinders." The Secretary presented, for Mr. ROBT. A. CUMMINGS, a Table of Radii of Curves in Inches, for the Reference Book. He also presented, for Mr. MICHAEL TRUMP, an illustrated paper on "Interlockings, Pittsburg Yard, Pennsylvania R. R." Mr. G. D. CHENOWETH presented an illustrated description of the Chenoweth conduit for electric wires.

HOWARD MURPHY, Sec. and Treas.

Connecticut Association of Civil Engineers and Surveyors.—The fifth annual meeting will be held at the office of the City Engineer, Hartford, Conn., on Jan. 8. Business will be transacted, officers elected, and reports of Committees received. A paper on "Iron Buildings" will be presented by C. M. JARVIS, and a topographical map of the old Continental camp ground at Redding, Conn., explained by HULL & PALMER. There will be discussions on several questions of interest.

Secretaries. { D. S. BRINSMADE, Birmingham,
E. P. AUGUR.

Ohio Society of Surveyors and Civil Engineers.—The Society will hold its tenth annual meeting in Columbus, O., on Jan. 8, 9 and 10, 1889. All engineers and surveyors are invited to be present and take part. A programme having papers upon land surveying, drainage, railway signals, limes and cements of the State, etc., has been arranged.

C. N. BROWN, *Secretary.*

Indiana Society of Civil Engineers and Surveyors.—The ninth annual meeting will be held in the office of the Auditor of State, Indianapolis, Ind., on Jan. 15, 16, 17. President, J. C. PULSE; Corresponding Secretary, LEWIS S. ALTER.

Ohio Institute of Mining Engineers.—The ninth annual meeting will be held at Columbus, O., on Jan. 10, 11. The following papers are on the programme; "Vessel Loading by Machine", W. B. HANLON; "Miners' Hospitals," Hon. ANDREW ROY; "Review of the Westward Extension of the Hocking Valley Coal Field", Prof. EDWARD ORTON; "Spring Pole Drilling," Hon. ANTHONY HOWELLS; "Coal and Clay of Muskingum Co.," BENJAMIN WHEELER; "Mine Surveying," F. A. RAY; "Experiments in Blasting," W. B. BROOKS, Jr.; "Mining and Railway Engineering," F. J. AID; "Electricity in Mining," C. W. JENKS; also papers by Hon. R. M. HAZELTINE and Prof. N. W. LORD. President, W. H. JENNINGS; Secretary and Treasurer, THOS. B. BANCROFT.

RAILRWAYS.

EAST OF CHICAGO.—Projects and Surveys.

Utica & Unadilla Valley.

BRIDGEWATER, Oneida Co., N. Y., Dec. 26, 1888.

EDITOR ENGINEERING NEWS.—

Surveys for this road were made several years ago by THOS. W. SPENCER, of Utica, N. Y., but the line was relocated by DELOS E. CULVER, in October, from Bridgewater through Leonardsville, South and North Edmonton to New Berlin, a distance of 19.3 miles. The work is light, the average grade being about 12 ft. to the mile. The principal centers served will be New York City, Utica, Oneida, Rome, Little Falls, Chicago and other towns. Fifty thousand dollars local aid has been secured and remaining capital for construction will be obtained by issuing stock. Contracts for a portion of the work will be let during the winter. Tracklaying will probably begin in May, 1889, and the road will be opened for traffic by July or August if right of way is all obtained. One thousand tons of 56-lb. rails have been purchased for future delivery. The company was incorporated Sept. 12, 1888. DELOS E. CULVER is Chief Engineer.

A. C. COUCH, *President.*

Scranton & Forest City.—The surveys for this proposed Pennsylvania road, which is said to be backed by the Erie and Jersey Central, have been about completed. The line would be about 25 miles in length. It is stated that the Delaware & Hudson Canal Co. is opposing the project and has laid tracks to prevent the new company from entering Scranton from the north.

Penn Mountain.—A press report from Reading, Pa., states that the construction of a gravity switch-back road similar to the one at Mauch Chunk, is to be soon undertaken. THOMAS P. MERRITT, J. E. ANCONA, and other Reading capitalists are interested.

Baltimore Belt.—Subscription books have been opened to the stock of this company, which proposes to build a road connecting all the lines entering the city of Baltimore. The capital stock is $1,500,000. WM. GILMOR, M. H. HOUSEMAN and JOHN H. MILLER are the incorporators. The enterprise is in the interest of the Maryland Central, Deer Creek & Susquehanna, and the Baltimore & Drum Point companies.

Windsor & Amherstburg.—A franchise has been asked for a railway line between these two points in western Ontario.

Gaspe.—A railway is projected to run from Metis, on the Intercolonial to Gaspe, and a charter has been asked from the Quebec Government.

Existing Roads.

Dexter & Piscataquis.—The contract for building this Maine road has been let to Brown Brothers, of St. Stephen, N. B.

Canadian Pacific.—

GREENVILLE, Me., Dec. 22, 1888.

EDITOR ENGINEERING NEWS:

The track of the International Ry. of Maine is all laid except that across the Onawa lake viaduct which will be completed before Jan. 1. All construction gangs are now paid off and ballasting stopped for the winter. The road will be open for traffic west of Moosehead lake during the winter and through traffic will begin as early as possible in the spring. The ex-contractors and engineers of this work have had a bad attack of the Chilian fever and a change of climate is recommended by the wise ones.

S. B. M.

Baltimore & Drum Point.—Contracts for grading the division between Baltimore and Millersville, Md., have been let. Work is to begin next month and be completed July next. Surveys have been made for the proposed branch to Washington, D. C. and for a belt road at Baltimore. Grading has been finished on 21 miles in Anne Arundel county and 21 in Calvert county.

Columbus, Lima & Northwestern.—The contract has been let to Stephen G. Clark, of Chicago, for the construction of this road from Columbus, O., to Saugatuck, Mich. It is intended to have the division between Columbus and Defiance, O., in operation by the autumn of 1889.

Lake Erie, Essex & Detroit River.—The first train over this road in Western Ontario, from Walkerville to Ruthven, was run on Dec. 15.

Allentown Terminal.—Whitney & Burke Bros. have the contract for this short road at Allentown, Pa. The work is heavy and several bridges will be required.

Kanona & Prattsburg.

PRATTSBURG, Steuben Co. N. Y., Dec. 21, 1888.

EDITOR ENGINEERING NEWS:

The survey has been made and right of way obtained for this road from Kanona through the towns of Bath, Wheeler and Prattsburg, a distance of 12 miles. The work is light, curves easy and maximum grade 1.4 per cent. The road will depend for its traffic upon coal, lumber and farm produce. Contract for construction is let to N. C. WILLIAMS, of Syracuse. Tracklaying will begin about Jan. 15, 1889, and the road be opened for traffic by the 1st. of April; $25,000 local aid has been secured. MARTIN PINNEY is President.

J. G. BAKER, *Chief Engineer.*

Cincinnati, Washington & Baltimore.—The Farmers' Loan & Trust Co., of New York applied to the Courts on Dec. 31, for the appointment of a receiver for this road and Judge PECK appointed Col. ORLAND SMITH, President of the company, and HENRY C. YERGASON President of the Merchants' Nat'l Bank of Cincinnati, to be joint receivers.

Baltimore & Ohio.—Grading began on Dec. 26, on the 6 mile branch which is to run from a point near Roselle, N. J., to the Arthur Kill bridge.

Deer Creek & Susquehanna.—Miller & Baldwin, contractors for this proposed Maryland road, have agreed to accept the $50,000 of stock subscriptions already made, and begin work on the line in January, completing it by October next. A meeting of stockholders will be held Jan. 8, to vote on the question of issuing bonds to aid the construction of the road. GEO. M. JEWETT, of Harford, Md., is President.

Cornwall & Lebanon.—Considerable work has been done on the preliminary surveys for the proposed extension to connect with the Schuylkill Valley division of the Pennsylvania; grading, however, will probably not begin till next spring.

Philadelphia & Reading.—The company has begun grading on a 3 mile branch to the Lehigh Valley system at Silverbrook, Pa. Right of way is being secured for a branch line from Rupert to Bloomsburg, Columbia county, Pa.

Lehigh & Hudson River.—It is rumored that the Pennsylvania officials will make arrangements to reach the Poughkeepsie bridge over this line, in common with the Central Railroad of New Jersey.

Pennsylvania, Poughkeepsie & Boston.—This company, which is the successor to the old Pennsylvania, Shatington & New England, is now pushing work on 10 miles of road between Deckertown, N. J., and Pine Island, N. Y. The contractor for building the whole line is WM. BAIRD, of Pittsburgh, and the subcontractors are Warner & Andrews of Newburg, N. Y. They are working a force of about 200 hands.

Cincinnati, Indianapolis, St. Louis & Chicago.—The heavy cut at North Bend, Ind., which has been under way for several months is at last completed and trains are running through it instead of the tunnel. The cost of the excavation was about $200,000.

Evansville & Richmond.—The city of Richmond, Ind., voted a subsidy of $115,000 to this company on Dec. 27. Grading is completed from Elnora to Odin.

Great Northern.—The extension from New Glasgow to Ste. Julienne, P. Q., on which track was reported laid in last week's issue, is not yet finished, work having been delayed by bad weather.

Toledo, Ann Arbor & North Michigan.—Work is reported in progress on the extension from Springville to Frankfort on Lake Michigan, 40 miles. A 20 mile branch to Manistee is said to be planned for the coming season's work.

Old Colony.—Surveys are about completed for the proposed branch from Attleboro to Walpole, Mass., and it is thought that it will be eventually pushed on to Dedham. Right of way is being secured and grading will probably be begun in the spring. A branch is proposed to run from South Hingham to No. Hanover.

Brookfield.—This 7 mile New York road, on which track was reported laid last week, has been unable to complete its work within the time reported to us on account of financial difficulties. The company is to be re organized.

Hereford.

COOKSHIRE, P. Q, Dec. 20, 1888.

EDITOR ENGINEERING NEWS:—

Grading on the above line will be all completed by the end of this month, 35 miles has been completed during the season, tracklaying and ballasting is well advanced and by Jan. 15 of 1889, it is expected that the steel will be all down. Freight trains will be run during the winter. This line connects with the Upper Coos Ry., one of the Boston & Maine branches.

It is proposed to extend the Hereford Ry., north to either Angus or Dudswell during the season of 1889. The location of this extension will be made during the winter.

D. WILLIAMS, *Chief Engineer & Supt. Construction.*

SOUTHERN—Existing Roads.

Atlantic & North Carolina.—The Board of Trade of New Berne, N. C., is considering the question of extending this road toward the interior of the State.

Cape Fear & Yadkin Valley.—About 42 miles of the extension from Fayetteville to Wilmington, N. C., have been graded. The whole distance is 84 miles. The contract has been let for an iron bridge 600 ft. in length across the Cape Fear river at Fayetteville, the structure to be finished by July 1.

Louisville, New Orleans & Texas.—Grading is reported in progress on the extension to connect with the West Feliciana Railroad, recently purchased by the company. The branch is about 16 miles in length. The branch just built in Bolivar county, Miss., will be pushed north to meet the main line.

Kentucky Central.—Mr. C. P. HUNTINGTON, who holds the controlling interest in this company, has decided to sell, and has issued a circular to other holders of the stock offering them the same terms he himself is to receive if they will sell. Who is to purchase the stock is not yet made public, and opinion seems to be divided as to whether the East Tennessee, Virginia & Georgia or the Louisville & Nashville is the more probable buyer.

Fordsville & Cloverport.—M. V. McCracken & Co., who have just built the Louisville, St. Louis & Texas, are to begin building this short road as soon as right of way is obtained. Most of this is already secured. No local aid is asked except $10,000 already voted by Cloverport. About 8 miles of the track of the Victoria coal road will be used to form the Northern end of the branch.

East & West Railroad of Alabama.—This road is a narrow gauge line extending from Cartersville, Ga., to Broken Arrow, Ala. It is proposed to widen the gauge of the road at an early day, and extend it to Gainesville on the east, and to Birmingham on the west.

South Carolina.—This company is unable to meet the January interest on its second mortgage bonds It is said that the line is likely to become part of the Richmond & West Point Terminal system at an early day.

Projects and Surveys.

Florence Northern.—

FLORENCE, Ala., Dec. 18, 1888.

EDITOR ENGINEERING NEWS:—

This road is to run due north from Florence, Ala., a distance of 70 miles, intersecting the Tennessee Midland in Perry county, Tenn. The surveys have already been made. The route as surveyed runs through a region rich in brown hematite ore and hard wood timber. The road, while carrying both passengers and freight, will depend mainly for its traffic upon the transportation of minerals and lumber. The work is about medium and grades generally will be about 1 per cent. There will be a bridge of 300 ft. over Buffalo river. Contracts for the construction of 25 miles will be let early in January, and this distance is expected to be finished in four months and the road opened for traffic by May 1, 1889. Local aid to the amount of $200,000 has been secured, and good progress is being made in obtaining right of way. The road was incorporated in November of this year. A. G. NEGLEY is Chief Engineer.

W. B. WOOD, *President.*

Montgomery & Sylacauga.—This company has been incorporated in Alabama to build a railroad between the points named, about 60 miles. Surveys are to begin soon. B. K. COLLIER, of Montgomery is at the head of the enterprise.

Cordele, Waynesville & South Brunswick.—The charter for this Georgia company has been issued and it is intended to begin work at once. W. F. PENNIMAN, of Brunswick, is President.

Hawesville & Pellville Mineral.—Surveys for this 12 mile Kentucky road will begin in a few days. Most of the right of way has been secured. D. L. ADAIR, of Hawesville, is President.

Owensboro, Falls of Rough & Green River.—The contract for building this Kentucky road has been let to the Central Construction Co. of Henderson, the road to be completed from Owensboro to Fordsville by Sept. 1, 1889.

High Point, Randleman, Asheboro & Southern.—Contracts for the first division of this North Carolina road, from High Point *via* Randleman to Asheboro, 26 miles, have been let and work is to begin very soon. J. ELWOOD WILCOX of High Point is President.

Atlanta & East Point.—ISAAC HAAS of Atlanta is the chief promotor of a suburban motor railway from Atlanta to East Point. A company is being organized, and it is hoped to begin work by the last of the present month.

Georgia.—The Legislature has passed the bills incorporating the Midville, Swainsboro & Red Bluff R. R. Co., the North & South Street R. R. Co. of Rome, the Elberton & Western Ry. Co. and the South Brunswick Terminal R. R. Co.

Paducah & Hickman.—This Kentucky company has just received $40,000 in local aid from the towns of Clinton Moscow and Spring Hill.

Wheeling, Wellsburg & State Line.—Surveys are nearly completed and right of way is nearly obtained for this road which is to run from Wheeling, W. Va., to Pittsburgh, Pa. Contracts for construction are to be let soon. SAMUEL GEORGE, of Wellsburg, W. Va., is President.

Paducah & Tennessee.—This projected north and south road, from Paducah across the States of Kentucky and Tennessee, has not been given up but is still being advocated by its promoters. THOS. H. PURYEAR, of Paducah, is at the head of the enterprise.

Wilmington & Ocean View.—This company, whose headquarters are at Wilmington, N. C., proposes to build a short motor line to the seacoast.

THE NORTHWEST—Existing Roads.

Chicago & Northwestern.—The business men of Galena, Freeport and Warren, are making efforts to induce the building of a line from Galena, the present terminus of the Southern Wisconsin branch, to Freeport. It is claimed that the managers have given assurances that the line would be built in the spring and that the surveys have already been made.

Centralia & Ste. Genevieve.—Work on the Illinois end of this road has met with an indefinite postponement on account of the refusal of the City Council to grant the road right of way through the city of Sparta. Mr. GILLETT, the manager of the enterprise, has gone to Centralia. The people of that town are offering inducements to have the construction begin there.

Chicago, Milwaukee & St. Paul.—Considerable work is being done on the Evanston branch of this line. The viaduct at Ridge Ave. is nearly finished and work has begun on the new depot at Noyes St.

Milwaukee & Northern.—It is reported that the next extension of this road will probably be made in the direction of Ontonagon, a distance of 60 or 70 miles. The extension will perhaps be started this year.

St. Paul & Duluth.—No new mileage has been added to this road during 1888, but a large amount of work has been done in improving the road. Double track has been laid from Duluth to West End Junction, and from St. Paul to Claymont, the latter to be extended to White Bear. Grade has been reduced in several places from 79 ft. to 15 ft. per mile. Five new depots have been built and four new iron bridges are being built across the St. Louis, Snake, Moose and Kettle rivers.

Winona & Southwest.—This company has a corps of surveyors in the field headed for Mason City, Ia.——Advantage is being taken of the mild winter to make final surveys. Mason City will probably be the division headquarters.

Missouri Pacific.—Suit has been brought against this company by the Fitzgerald & Mallory Construction Co. to collect $1,500,000 claimed to be due for work done in 1887 on the Denver, Memphis & Atlantic extensions.

Duluth & Winnipeg.—This company finished 20 miles of their line from Cloquet, Minn., north, before the end of the year instead of 5, as reported in last week's summary. The work was hurried to completion in order to make good the company's title to its large land grant.

Projects and Surveys.

Nebraska, Dakota, Wyoming & Pacific.—A charter for this company has been filed in Nebraska, to build a railway from Omaha northwest to the Dakota State line, with a capital stock of $10,000,000. Among the incorporators is J. F. DILLON, of New York, general solicitor for the Union Pacific Ry. Co.

Milwaukee & Wauwatosa Motor.—This company has been chartered at Milwaukee, Wis., and will build a short suburban line early in the spring. A. B. MEYERS, EVERETT A. SMITH, W. S. JOHNSON and others are interested.

Minneapolis, St. Paul & Southwestern.—The preliminary survey for this proposed line is now in progress between Minneapolis and Des Moines.

Escanaba, Twin Cities & Western.—It is reported that a line by this name is projected to parallel the Minneapolis, St. Paul & Sault Ste. Marie from Minneapolis to Escanaba, Mich. The proposed line would be about 350 miles in length, and the probabilities of its construction would seem to be very small.

Danville, Chicago & Northwestern.—The charter has been filed in Illinois for this company which is to build the link connecting the Cairo, Vincennes & Chicago and the Wabash railways, and furnish a direct route from Chicago to Cairo. Officers of the two companies constitute the incorporators.

Manitoba & Southeastern.—This company will apply for a charter to build a railway from Winnipeg to a point on the International boundary east of the Red river, with two branches. Munson & Allen, of Winnipeg, are the company's solicitors.

British Columbia.—Application is to be made to the legislature of this Province at the coming session for permission to build a railway "from some point at or near Butte inlet, through the Chicoten and Cariboo districts and Yellowhead pass to connect with the extension of the Manitoba & Northwestern."

THE SOUTHWEST—Existing Roads

Kansas City, Fort Scott & Memphis.—A bill is before the U. S. Senate granting right of way to an extension of this system, to be known as the Cherokee Central Railway, through the Indian Territory to Ft. Smith, Ark.

Kansas City & Pacific.—This company has just finished its extension to Paola, Kan., making the entire length of its line 125 miles. It is contemplated to extend the road next season south through the Indian Territory, and to run trains from Paola to Kansas City, either by building a new line or securing trackage over one of the existing roads.

Chicago, Rock Island & Pacific.—It is reported that a party of engineers have just started out to make surveys from Liberal, Kan., toward Trinidad, Col., and El Paso, Tex.

Arkansas Midland.—This Arkansas company is negotiating with the Pine Bluff & Swan Lake Company for a consolidation of the two lines. The proposed extension to Little Rock may then be undertaken.

Texas & Pacific.—It is reported that this company is trying to secure a concession from the Mexican Government for a bridge across the Rio Grande river at El Paso.

Projects and Surveys

Dallas, Archer & Pacific.—The old charter, right of way, etc., of this company has been bought by M. H. MCLAURIN of New York, who pays the debts of the old company and $8,000 in cash. The road is to run from Dallas through Clay, Jack and Archer counties in Texas.

New Orleans, Natchez & Ft. Scott.—The engineering corps have now about completed the survey to Sicily Island, some 27 miles northwest of Vidalia, La.

Camden & Warren.—The preliminary survey for this proposed Arkansas road is in progress between Camden and Warren. The enterprise, which was first started several years ago, has been revived. Right of way is being secured and work on construction will begin at once. Col. W. B. SLACK of Little Rock, Ark., is interested.

Louisiana Arkansas & Missouri.—The contract to build this road from Brinkley, Ark., to Monroe, La., is let to Post, Martin & Co., of New York. William Black and others have the contract for the division between Brinkley and Indian Bay.

Kansas City, Arkansas & New Orleans.—It is stated that construction on this road, which is to run from Springfield, Mo., to New Orleans, will commence at Beebe, on the Iron Mountain road, about Feb. 1. The Arkansas Division will be built first.

Red River, Sabine & Western.—This company has been organized at San Augustine, Tex., to build a road from Palestine, Tex., to Cheneyville, La., via New Birmingham, Nacogdoches and San Augustine. It is reported that right of way has been bought for 30 miles, and negotiations are in progress for the contracts for grading this section. T. T. LLOYD, of Marshall, is President; W. J. T. EVANS, of Clarksville, Vice President; F. H. TUCKER, of San Augustine, Secretary; and I. H. HOLLIS, of San Augustine, Treasurer.

St. Louis, Omaha & Northwestern.—A meeting was held recently at Louisiana, Mo. to consider the subject of continuing the survey of this road and to solicit subscriptions for the purpose. The route has already been surveyed from Plum Creek to Leon, passing through Monroe City, Shelbyville, Locust Hill, Kirksville and Unionville.

ROCKY MT. AND PAC.—Existing Roads.

Rocky Fork & Cooke City.—It is stated that this Montana road, on which considerable grading was completed at the time of the stoppage of work last year, is to be finished by Hon. SAMUEL T. HAUSER. This report if true, would indicate that the line is to be operated as a branch of the Northern Pacific.

San Francisco & Northern Pacific.—Work is to begin at an early date on an extension from Santa Rosa to Sebastopol.

Seattle, Lake Shore & Eastern.—Correspondence has been published between President GILMAN of this company and President VAN HORNE of the Canadian Pacific, in which the latter promises to begin construction at once on an extension from Mission, B. C., to the International boundary, where junction will be made with the extension of the former road now building north from Seattle. The Canadian Pacific will have about 15 miles to build and the Seattle road about 85.

San Diego, Cuyamaca & Eastern.—Mr. B. B. WHITNEY of Kansas City is in charge of the engineering department of this new California road, and informs us that 22 miles from San Diego to Lakeside are nearly graded and tracklaying is to commence this month. Surveys for further extensions are to begin soon. Mr. G. W. SCHNELLBACHER, of San Diego, is General Manager.

Denver & Rio Grande.—Scullin & Stacy, of St. Louis, have taken the contract for building the Lake City branch.—It is thought that the company will soon begin work on a branch in the San Luis Valley, and one in San Miguel and Dolores counties. The Denver, Clear Creek & Western Company has been chartered to build a road up Clear Creek cañon.

Texas, Santa Fé & Northern.—It is planned to begin work soon on an extension from Santa Fé, N. M., south to tap a rich mining region.

Projects and Surveys.

Eureka Railroad & Coal Co.—Incorporated in California to build a railway from a point in Alameda county to a point in San Joaquin county, about 20 miles. R. D. MCELROY and A. R. GREEN, of San Francisco, and F. R. NOYES, of Oakland, are among the incorporators.

Trinidad & Rocky Mountain—Incorporated in Colorado to build a railroad from Trinidad to Las Vegas, N. M., by JOHN R. WEEKS and others.

Fairhaven & Southern.—This company has been chartered in Washington Territory by NELSON BENNETT and others to build a railroad from some point on Bellingham bay to the Columbia river.

Pueblo, Gunnison & Pacific—Chief Engineer HORACE ROPES has finished the preliminary survey of this Colorado road, and it is intended to secure capital and build the road the coming season.

CONTRACTING.

Steam Pump.—The following proposals for a steam pump for the U. S. Marine Hospital at New Orleans, La., have been received by Surgeon CHAS. B. GOLDSBOROUGH, Custodian: Louis Schwartz, New Orleans, $490; John Murphy, New Orleans, $548; Edwards & Haubtmon, New Orleans, $685; Manion & Co., New Orleans, $691. The contract has been awarded to Louis Schwartz.

Dredging.—The following proposals were opened Dec. 29 by Mayor M. B. ADAMS, U. S. Engineer Office, Burlington, Vt.: In Ticonderoga river, 15,000 cu. yds.; Luther Whitney, Keeseville, N.Y.; 11 cts. per cu. yd.; Wm. James Daly, Ogdensburg, N. Y., 14 cts.—In Otter creek, 14,000 cu. yds.; Luther Whitney, 14 cts.; Wm. James Daly, 14 cts. per cu. yd. for 3,000 cu. yds. in place, and 25 cts. per cu. yd. for 11,000 cu. yds. scow measurement.

The following proposals for dredging in Oakland harbor, Cal., have been received by Col. GEO. H. MENDELL, U. S. Engineer Office, San Francisco, Cal.: In the basin; San Francisco Bridge Co., 14.7 cts. per cu. yd.; Von Schmidt & McNae, 16 cts. In the canal; San Francisco Bridge Co., 17.7 cts.; San Francisco Contract Co., 24½ cts.; B. McMahon & Son, 24¾ cts.; S. Antonelli, 33 cts.; Von Schmidt & McNae, 47 cts; J. Kelso, 52 cts. In the jetty channel; San Francisco Bridge Co., 32.7 cts.; Pacific Coast Dredging & Reclamation Co., 33⅓ cts.; Von Schmidt & McNae, 35 cts. Along the city front; Von Schmidt & McNae, $1; Pacific Coast Dredging & Reclamation Co., $1.15

Viaduct.—The following proposals for the construction of the Hawk St. viaduct at Albany, N. Y., were opened Dec. 24 by the Hawk St. Viaduct Commissioners: Hilton Bridge Construction Co., Albany, N. Y., $87,336.50; Sullivan & Ehlers, Albany, $88,337, Rochester Bridge Works, Rochester, N. Y., $91,000; Berlin Iron Bridge Co., East Berlin, Conn., $92,133; Edge Moor Iron Co.* Wilmington Del., $96,500; King Iron Bridge & Mfg. Co., Cleveland, O., $100,500; Wrought Iron Bridge Co., Canton, O., $101,335; Groton Bridge Co., Groton, N. Y., $105,990. The contract was awarded to the Hilton Bridge Co., at $87,336.50; this company also has the contract for the substructure, at $19,663.50, making a total of $107,000. The engineer is PALMER C. RICKETTS, of Troy, N. Y.

Jetty and Retaining Wall.—The following proposals have been received by Lieut. O. M. CARTER, U. S. Engineer Office, Savannah, Ga.—— Training wall at mouth of Savannah river: Wm. T. Gaynor, Fayetteville, N. Y.; $3.19 per cu. yd. for stone, $1.29 per cu. yd. for oyster shells, 63 cts. per sq. yd. for mattresses, total $168,550; Anson M. Bangs, Fayetteville, N. Y.; $3.28, $1.38, 67 cts., $176,600; Alabama Dredging & Jetty Co., Mobile, Ala., $3.24, $1.40, 69 cts., $178,000; P. Sanford Ross, Jersey City, N. J., $3.05, $1.44, 74 cts., $179,050.——Jetty at entrance to Cumberland sound; Anson M. Bangs, $3.27 and $1.27 per cu. yd. for stone and oyster shells, total $123,500; Wm. T. Gaynor, $3.25 and $1.34, $124,300; P. Sanford Ross, $3.28 and $1.37, $125,800.

Sea Wall.—The following proposals for repairing the granite sea wall at the Naval Hospital, Norfolk, Va., have been received by J. MILLS BROWNE, Surgeon General, U. S. N.: A. J. McFrederick & E. R. Berry, Baltimore, Md.; $15,698; Jno. Lane & A. Malvati, Washington, D. C., $16,518; Owen Patterson, Baltimore, Md., $16,574; Patrick Linehan, Raleigh, N. C., $17,077.50; Francis H. Smith, New York City, $17,394; George Magaw, Baltimore, Md., $18,660; Geo. W. Rowler, Libertytown, Md., $24,856. The contract was awarded to A. J. McFrederick & E. R. Berry.

Railway Track, Bridge, Buildings, Etc.—The following proposals for work at the Watervliet Arsenal were opened Dec. 24, by Col. J. M. WHITTEMORE, U.S.A.; the work is as follows: Item No. 1, constructing railway line; Item No. 2, wrought-iron railway bridge; Item No. 3, masonry abutments for bridge; Item No. 4, preparing site and excavating foundations for shop buildings; Item No. 5, two sets of brick quarters: No. 1; Jacob Holler, Albany, N. Y., $7,000 per mile for furnishing and laying track, 30 cts. and $1.15 per cu. yd. for rock and earth excavation, $1,010 for all turnouts and crossings; Emmett Flagler, Troy, N. Y., $19,451; Broderick, Jackson & Co., Troy, N. Y., $41,600 for Nos. 1 and 4; Houlihan & Fisher, Cohoes, N. Y., $14,700; Malone & McKenna, Troy, N. Y., $15,334.——No. 2: R. F. Hawkins, Springfield, Mass., $6,392.50; Jacob Holler, $6,355; Vermont Construction Co., St. Albans, Vt., $7,123.91; New Jersey Steel & Iron Co., Trenton, N. J., $6,364; Mt. Vernon Bridge Co., Mt. Vernon, O., $6,500; King Iron Bridge & Mfg. Co., Cleveland, O., $7,112; Berlin Iron Bridge Co., Berlin, Conn., $6,412.——No. 3; Jacob Holler, earth excavation and backfilling, 60 cts. per cu. yd.; rock excavation, $1.15; bailing and draining, $300; $10 and $6 per cu. yd. for 2nd and 3rd class masonry; Emmett Flagler, Troy, N. Y., $2 per cu. yd. for earth excavation; $15 and $8 for 2nd and 3rd class masonry; Malone & McKenna, $4,439.——No. 4; Cusack & Weeks, West Troy, N. Y., 80 cts. per cu. yd. for leveling site, $8 per cu. yd. for shrinkage pit, $1.25 per cu. yd. for trenches; Emmett Flagler, $1, $5, $2; Houlihan & Fisher, $1.25, $4.50, $1.50; Broderick, Jackson & Co., $41,600 for Nos. 1 and 4.——For Nos 1, 2, 3 and 4, Elnathan Sweet, of Albany, N. Y., bid $34,900, and the contract was awarded to him. All the bids on No. 5 were rejected as too high.

MANUFACTURING & TECHNICAL.

Market Prices—*Steel Rails.*—Pittsburg, $28. Chicago, $30. At eastern mills prices have been uncertain.

Railway Track Supplies.—New York; spikes $2.10 @ $2.15 for large lots, delivered; angle bars, 1.85c. to 1.9c. Pittsburg; spikes, $2.10, 30 days; splice bars, $1.80 to $1.85; track bolts, $2.80 with square and $2.90 with hexagon nuts.

Old Material.—New York; tee rails, $23.25; double-head rails, $24. Pittsburg: old steel rails, $18.50 for short and $20.50 for long lengths; No. 1 wrought scrap, $21, net ton; wrought turnings, $13 @ $14; car axles, $25 @ $26; cast scrap, $15.25 @ $16, gross; cast borings, $12 @ $13; old car wheels, $19.50 @ $20. Chicago; old iron rails, $22.25 @ $22.50; old steel rails, $16 @ $20 according to length, etc.

Structural Iron.—New York; sheared plates, 2c. @ 2.1c.; universal mill plates, 2.1c. @ 2.2.c; angles, 2c. @ 2.10c.; tees, 2.3c. @ 2.6.; channels and beams, 3.3c. on dock for all sizes; foreign beams, 2.55c @ 2.75c.; Chicago; at mills f.o.b.; angles, 2.15c.; universal plates, 2.20c. @ 2.25c.: tees, 2.55c. @ 2.60c.; beams and channels, 3.50c.; store prices, 2.35c @ 2.50c. for angles; 2.60c @ 2.70c for tees, 3.80c. for beams. [Compiled from *Iron Age.*]

Car Notes.—The Muskegon Car Works, of Muskegon, Mich., have orders on hand for 600 cars; 500 being for the Chicago & Atlantic and 100 for an Ohio road.

The Barney & Smith Mfg. Co., of Dayton, O., has the contract for 500 box cars and 500 coal cars for the Chesapeake & Ohio.

The Lafayetteville Car Works, of Lafayette, Ind., have an order for 100 refrigerator cars.

About 1,000 new cars are to be built for the Chicago, St. Paul & Kansas City road.

The Pennsylvania road has placed an order for 2,500 box cars, and is building a large number at its Fort Wayne shops. For the lines west of Pittsburg (Pittsburg, Cincinnati & St. Louis, and Chicago, St. Louis & Pittsburg) contracts for 2,000 cars have been placed as follows: Ohio Falls Car Co., of Jeffersonville, Ind., 1,000 box cars; Peninsula Car Co., of Detroit, Mich., 500 gondola cars; Missouri Car & Foundry Co., of St. Louis, Mo., 500 stock cars. All are to be fitted with the Janney coupler, and all except the gondolas with the Westinghouse brake. All new freight cars for the Pennsylvania lines are to be fitted with the M. C. B. automatic coupler, and all stock and box cars with air-brakes. During the past year, 1,300 freight cars were added to the equipment, but a large number more are required.

The Central Railroad of Georgia will soon give out orders for 1,000 box cars and 1,000 fruit cars.

The Philadelphia & Reading and the Central of New Jersey will each give out orders for 500 hopper-bottom gondola coal cars.

Locomotives.—The Rogers Locomotive & Machine Works, Paterson, N. J., have delivered some of the eight-wheel passenger engines for the Eastern Ry. of Minnesota. The contract is for 18 engines. These engines have 18 x 24-in. cylinders, 63-in. driving wheels, with Krupp steel tires, and Boies steel-tired wheels on the engine and tender trucks. One passenger engine has been shipped to Cuba, and another to Nova Scotia. Two new engines for the Nashville, Chattanooga & St. Louis road, are fitted with the Luttgens variable exhaust damper at the base of the smokestack. Ten switching engines were built last year for the Lake Shore & Michigan Southern.

The Schenectady Locomotive Works, of Schenectady, N. Y., have delivered 4 ten-wheel engines for the new Cincinnati division of the Chesapeake & Ohio. The engines have cylinders 19 x 24 ins, and weigh 64 tons. For the Southern Pacific, 15 ten-wheel engines, with cylinders 18 x 24 ins., have been recently built; also 20 twelve wheel engines, with 20 x 26-in. cylinders. There have also been delivered two switch engines, with 18 x 24-in. cylinders, for the Chicago Belt Ry. and an eight-wheel engine, with 17 x 24-in. cylinders, for the Dayton & Union road. The works are running full time and have a number of orders on hand.

The Rhode Island Locomotive Works, of Providence, R. I., have recently turned out 5 heavy freight engines for the Louisville, New Albany & Chicago, and 3 engines for the Western of Alabama. An order of 15 engines for the Chicago, Burlington & Quincy is now in hand.

The Manhattan Ry., New York, will soon order 25 new engines of its standard Forney type. The weight is 46,000 lbs. in working order. They are built to plans and specifications furnished by the company.

Logging Engines.—Locomotives for logging railways will be purchased by Geo. Schafer, of Truckee, Cal., and J. E. & Edward Rogers, of Stony Point, Va.

Water Motor.—The Belknap Water Motor Co. has been organized at Portland, Me., to undertake the manufacture of Belknap's "Little Giant" water motor, which has already had a considerable sale in different parts of the country. Capital stock, $5,000. GEO. W. BROWN is President and General Manager.

Vulcanite Paving.—The Southern Vulcanite Paving Co., of Savannah, Ga., has started its works. It has contracts for several miles of paving in that city.

Artificial Stone.—The Graham Patent Artificial Stone Co. has been organized at New Orleans, La., by GEO. H. DUNBAR, GEO. M. GRAHAM and WALTER P. SAXON Works are to be built shortly.

Pumps.—The Dow Steam Pump Works, of San Francisco, Cal., have the contract for all the pumps for Claus Spreckels' new sugar refinery in Philadelphia, Pa., including 4 pumps with a daily capacity of 12,000,000 galls. The works have also built the pumps for the San Diego & Coronado Water Co. and for the Paso Robles, Cal., waterworks. All kinds of pumps are manufactured at these works.

Trade-Note.—The Columbia Bridge Co., of Dayton, O., has for some months been running its works in the evening. A new blacksmith shop is being built and other improvements made to enable the company to handle the many orders now in hand.

Construction Companies.—The International Construction Co. has been incorporated at Chicago, Ill., by LAWRENCE P. BOYLE, JOHN RITCHIE and JOHN R. JAMES, to build and equip railroads, etc. Capital stock, $50,000. ——The Western Contract & Construction Co. is to be incorporated at Montgomery, Ala., by an act of the State legislature.

Catalogue.—The Thomson-Houston Electric Co., of Boston, Mass., has issued a large and handsomely printed and illustrated catalogue of its electric plant, different

classes of arc and incandescent lamps and apparatus, dynamos, motors, etc. There is a list of companies and the number of lights on this system, a list of cities and towns in which local companies are using the system, and a list of the company's plants; also a list of gas companies using the system.

PROPOSALS OPEN.

Pipe, Etc.—About 2,397 tons of 1¼-in. to 30-in. cast-iron pipe; cast-iron pipe fittings and specials; brass stops, ferrules and special castings. ROBERT K. MARTIN, Chief Engineer, Water Department, Baltimore, Md. January 7.

Bridge.—OLIVER N. WILDS, Natchez, Miss. January 7.

Sidewalks.—Flagging sidewalks. JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. January 8.

Iron Castings.—For the current year. T. A. HUGUENIN, Superintendent of Streets, Charleston, S. C. January 8.

Pier Work and Dredging.—Building new crib bulkheads and appurtenances at Lincoln Ave., Harlem river; also dredging thereat. THE DOCKS COMMISSIONERS, Pier "A", North river, New York City. January 11.

Water Supply, Sewerage and Sewage Disposal.—Trenching; furnishing and laying 5,600 ft. of 6-in. and 1,400 ft. of 4-in. water pipe of No. 16 sheet iron, and 700 ft. of 2-in. wrought-iron, screw pipe; valves, faucets, etc., to conform to the plans of the sewerage system. Also furnishing a continuous flow of 2 cu. ft. of water per second for 5 years. Also for disposing of the sewage for 5 years. Specifications on file. W. B. DENNETT, City Clerk, Fresno, Cal. January 14.

Water Bonds.—For $100,000, 5 per cent. PHILIP C. SCHUYLER, Clerk of the Water Committee, Portland, Ore. January 15.

Dock Work and Dredging.—At Norfolk, Va. About 2,800 lin. ft. of wharves; 6,000 piles driven; 130,000 cu. yds. dredging; 6 warehouses, covering about 160,000 sq. ft. Plans and specifications on file. G. M. SERPELL, General Manager and Chief Engineer, American Construction Co., 100 Main St., Norfolk, Va. January 15.

Water Pipe, Gates, Etc.—Cast-iron pipe, 4,000 ft. of 4-in., 100,000 ft. of 6-in., 27,000 ft. of 12-in., 30,000 ft. of 16-in., 4,700 ft. of 20-in.; 150 tons of special castings. Valves, 4-in., 6-in., 12-in., 16-in. and 20-in.; the 16 and 20-in. sizes to be geared. Brass taps, etc. JOHN CAULFIELD, Secretary, Board of Water Commissioners, St. Paul, Minn. January 15.

Sewers and Water Pipe.—Brick sewers, catch-basins, manholes, etc. Also 6,150 ft. of 6-in. cast-iron water pipe. W. B. DAVIES, City Recorder, Mankato, Minn. January 19.

Sewers.—About 8.6 miles of main intercepting sewer from 24-in. pipe to 78-in. brick. Plans and specifications at the office of R. R. MARBLE, City Engineer. H. E. BRYAN, City Clerk, Columbus, O. January 21.

Railway.—Between Brantford & Waterford, 17 miles. GEO. H. WILKES, President, Brantford, Waterloo & Lake Erie Ry., Brantford, Ont., Canada. January 22.

Sewers.—At Fulton, N. Y. Engineers, LANDRETH & FITZGERALD, Schenectady, N. Y. M. C. HIGHRITER, Village Clerk, Fulton, N. Y. January 22.

GOVERNMENT WORK.

Dredging.—Dredging and removing ledge in York harbor, Me. Lieut. Col. JARED H. SMITH, U. S. Engineer Office, Portland, Me. January 10.

Foundations.—Excavation and pile and concrete foundation for U. S. building at Charleston, S. C. WILL A. FRERET, Supervising Architect, Treasury Department, Washington, D. C. January 12.

Road.—Macadam road at the national cemetery, Marietta, Ga. Major E. B. KIRK, U. S. A., Atlanta, Ga. January 15.

Barges.—Building 50 wooden barges. Capt. CHAS. F. POWELL, Mississippi River Commission, St. Louis, Mo. January 17.

Dams and Dikes.—In the Ohio river; a dam between Davis & Neville Ids., a dam at head of Marietta Id., a dike at Eight Mile Id., a dike at Bonanza bar, a dike at Madison, Ind., and a dike at Caseyville, Ky. Lieut. Col. WM. E. MERRILL, U. S. Engineer Office, Cincinnati, O. January 30.

BRIDGES AND CANALS.

Bridge Notes.—*Troy, N. Y.*—A new bridge across the Poestenkill at Spring Ave. is to be built this spring, to replace the existing old covered bridge.

Asbury Park, N.J.—The two iron bridges across Wesley lake have been completed. Traffic will be free except from June 1 to Oct. 1, when pedestrians will pay a 1 ct. toll.

Uniontown, Pa.—An iron bridge is to be built over Beeson's creek at West Fayette St.

Evansville, Ky.—The Ohio Valley Ry. Co. proposes to build a bridge over the Ohio river.

New Haven, Ky.—The new bridge over Rolling Fork is completed. It replaces an old bridge that was blown down about 8 months ago.

Fayetteville, N. C.—The Cape Fear & Yadkin Valley Ry. Co. has let the contract for the substructure of its bridge across the Cape Fear river, and work will be commenced this month.

New Berlin, Ill.—The iron bridge across Spring creek has been completed and accepted by the commissioners. It was built by the Wisconsin Bridge & Iron Company, and cost about $1,800.

Grand Rapids, Wis.—A winter bridge has been built across the Wisconsin river between Grand Rapids and Centralia.

La Crosse, Wis.—A vote will be taken Jan. 8 on the proposition to issue $70,000 for building a bridge.

Coteau, Que.—The Dominion Govt. has authorized the Canada Atlantic Ry. Co. to build a bridge over the St. Lawrence river. The total length of bridge and approaches will be 4,500 ft. The cost will be about $1,000,000

Chincoteague Canal.—The contract for digging this Maryland canal has been let to Joseph H. Haines, of Cape May, N. J., at 17½ cts. per cu. yd. Work is to be completed in 7 months. The canal will be 4 miles long and 20 ft. wide; it will connect Chincoteague bay with Indian river. The amount available for the work is $66,000.

The Water Power Canal at Westfield, Conn., has been purchased by the New Haven & Northampton Ry. Co.; the company paying $6,000 for all the interest of the Westfield Power Co. The canal will be filled up, enabling the railway to lay a double track.

Pontchartrain Canal.—The Mississippi River & Gulf Canal Co. is to be organized at New Orleans, La., by H. F. COTTAM, ISIDORE HERNSHEIM, G. R. FINDLAY, and others to build a canal from the Mississippi river to Lake Pontchartrain, 5 miles.

Dry Docks.—The dry-dock near Keokuk, Ia., is nearly completed; it is 400 ft. long, 100 ft. wide and 7 ft. deep. It was built by the U. S. Engineers at a cost of about $125,000.——The dry-dock to be built at Kingston, Ont., for the Dominion Govt. will be 300 x 72 ft. on the coping and 240 x 40 ft. on the floor. It will be built of stone and will cost $300,000.

The Palmetto Land, Lumber & Transportation Co. is to be incorporated in South Carolina by W. N. JORDAN, and others, to build a canal from the Santee river to Winyan bay, 5 miles. Capital stock, $50,000.

New York State Canals.—The Executive Committee of the Union for the Improvement of the Canals will present a bill to the Legislature appropriating $1,000,000 to continue the work of canal improvement. Last year's bill will be made the general basis of the one now to be drawn up. ORLANDO B. POTTER, FRANK S. WITHERBEE, of Port Henry, and FRANK S. GARDNER, of New York, form the sub-committee which will prepare the bill.

Viaduct.—City Engineer EVANS, of Lowell, Mass., has prepared estimates for a viaduct across the canals to Liberty square. The estimate for a stone viaduct 50 ft. wide is $214,200. The estimate for an iron superstructure on stone piers is $103,000.

WATER AND MUNICIPAL.

Centrifugal Filter.—The Centrifugal Filter Co., of New York, owns patents on apparatus for the filtration and aeration of water by centrifugal force. The filter consists of a vertical cylinder of copper with very fine perforations, revolving inside an outer cylinder at a speed from 1,600 revs. per minute for the small sizes to 800 revs. per minute in the large sizes. The sizes of the revolving cylinders range from 15 to 60 ins., with capacities of 2,000 to 250,000 galls. per day. The cylinder is first set in motion, being driven by belting, and when at full speed the necessary quantity of filtering material is introduced, in pulp form; this is plastered against the walls of the cylinder by the centrifugal force and forms a "felting" of such density that nothing but liquid can pass through it. The water is then turned on and is driven through the material by the centrifugal force; the solid impurities are worked up to the top of the cylinder and projected into a separate chamber.

Philadelphia, Pa.—The report of the Department of Public Works for the year 1887, has been published, and from it we take the following particulars. After April 1 the city gas works, which had been under the control of trustees of the Philadelphia Gas Works, were put under the control of the Department of Public Works. The amount of gas manufactured, and of residuals produced, was largely in excess of previous years, while the cash receipts, notwithstanding the reduction in the price of gas from $1.66 to $1.50 per 1,000 cu. ft. was greater than during any of the previous 10 years. The amount of coal carbonized was 671,631,600 lbs., which at 4.70 cu. ft. to the pound equals 3,154,842,000. At the end of that year there were 117,546 meters, 129,788 cu. ft. services, 1,980,999 lights, 118,644 consumers and 16,473 public lamps. The average light was 17.65 candle power. Larger gas mains are required in some parts of the city. Except at the 9th Ward works, gas is said to be made after the most antiquated and expensive methods, and it is recommended that new plant should be put in, with regenerative furnaces. The city has 354 electric arc lights.

The Department has charge of the maintenance and repairs of 181 bridges. The cobble and rubble stone pavements are being gradually replaced with improved pavements, at an average cost of $3,600 per running square or block in streets 50 ft. between house lines. The Traction Co. has been repairing with Belgian blocks along its tracks. About 22.57 miles of main, branch and lateral sewers were built. LOUIS WAGNER is the Director of the Department.

Sewers.—*New Bedford, Mass.*—The City Council has appropriated $10,000 for sewers.

Columbia, Tenn.—A sewerage system is projected. Address the mayor.

Brunswick, Ga.—It is proposed to issue bonds for the construction of a sewerage system.

Savannah, Ga.—The City Council has adopted the plans recommended by W. J. WINN, City Engineer, for the drainage of the city. There are to be 30 miles of sewers built, at a cost of $348,000.

Sheffield, Ala.—The city proposes to apply for power to issue bonds for $100,000 for a sewerage system and $30,000 for street work.

Seattle, Wash. Ter.—Col. GEO. E. WARING has been investigating the sewers with a view to reporting on an improved system.

Redwood City, Cal.—The Trustees are contemplating the establishment of a sewerage system.

Meters—At Camden, N. J., the Water Committee will see that water meters are placed in every manufacturing establishment.

Sewers.—*Newark, N. J.*—Contracts have been awarded as follows: Harper & Iliff, 94 and 99 cts. per ft. for pipe, $2.25 per ft. for brick sewer, $98 for basins, $29 for manholes; Hughes & Flynn, 75 cts. for pipe, $100 for basins, $27 for manholes.

St. Louis, Mo.—August Heman has completed his contract with the city for the construction of sewers in Vandeventer Ave., Sewer District No. 1. The area drained is 566 acres. Length of sewers, 16.743 miles. The work is paid for by special tax, levied on the property drained. The contractor received no payment during the progress of the work, and will collect the tax bills himself. The following were the costs per ft.: brick, $3.011 for 24 x 36, $3.427 for 29 x 41, $3.685 for 36 x 48, $4.061 for 41 x 53, $4.4 for 48 x 60, $4.475 for 48 x 65, $4.834 for 53 x 72 ins., $7.358 for 75-in. diameter, $7.918 for 72-in., $7.889 for 75 in.; $12.499 for 78-in., $9.987 for 93-in., $10.714 for 96-in., $11.482 for 99-in., $7.653 for 102-in.; vitrified pipe, $0.893 per ft. for 12-in., $0.934 for 15-in., $1.291 for 18-in.; street inlets, $51.793 each; manholes on brick sewers, $39.893 each; manholes on pipe sewers, $47.858 each. Total cost of sewers and apputtenances, $243,591.09; average cost of sewer per mile, $14,548.83; average cost per acre drained, $430.38. Special tax per sq. ft., excluding area of streets and alleys, $0.014565. The 102-in. and 78-in. sewers were through deep rock cuts. Brick sewers, 66-in. and over in width are 3-brick work, smaller sizes 2-brick. The sewers were planned and superintended by the Sewer Department, ROBERT E. MCMATH, Commissioner; WILLIAM WISE, Assistant Commissioner.

Jersey City, N. J.—The Board of Public Works officially decided on Dec. 17, that the polluted water of the Passaic river that is served to the citizens now is not such as any city should use; that a new supply is demanded, and that as the people seem to be opposed to the getting of a private supply, steps be taken to secure a public supply. A committee was appointed to apply for legistion enabling the city to extend its pipes to the mountain watershed of the State, and to do the other things necessary to draw a supply of water from it. It was also decided to communicate with the Newark authorities in the hope that that city will join with Jersey City establishing a joint water supply.

Newark, N. J.—The question of a new and improved water supply is under consideration. The North Jersey Water Co., of which JULIUS H. PRATT is the head, has made a proposition to furnish a supply: the company has water rights in what is known as the Pequannock valley. The Pequannock river drains an extensive territory to the west and northwest of Pompton; it empties into the Pompton river at the village of Pompton, and is one of the important feeders of the Passaic. The plan is to build a dam at a point a few miles west of Bloomingdale on the Pequannock, as Mr. PLATT's claims include a narrow strip of territory along the Pequannock, about 3 miles in extent, at the point where the outlet of the Machopin pond joins the Pequannock and along the outlet of the Machopin to the dam at the foot of that sheet of water. This would flood the country for a long distance back on the Pequannock river, and an immense quantity of water could be stored. The Pequannock valley at this point is very narrow, but it extends several miles, and has many ramifications, and the fall is considerable. The plan for the new supply contemplates a gravity system. The elevation, at a point above Bloomingdale, is some 300 ft. above tide-water. There are few points in the city over 200 ft. above tide-water, and none over 230; on High St. the elevation is 50 to 90 ft. The scheme as proposed is to complete the work to the city line and turn it over to the city at a round sum. This will be fixed, and will be about $2,000,000. The city is to own the plant absolutely and the present service pipes will be used within the city limits. The syndicate controlled by JOHN R. BARTLETT, some time ago made an offer to supply the city at $36.50 per 4,000,000 galls., but he now asks $40. Mr. BARTLETT is said to control nearly all the desirable ponds suggested by Messrs. CROES and HOWELL, in the report of 1879, as the most suitable for storage purposes in the entire water-shed.

Olean, N. Y.—The village recently advertised the issue of water bonds for $12,500 for the purchase of additional pumping machinery, and they have been awarded to GEO. A. BENWELL, 6 Wall St., New York. The total indebtedness, and amount of issue outstanding, is about $95,000. Population of village, about $8,000. Assessed valuation, about $2,800,000; real valuation, about 3,600,000.

Dennison, O.—The new water-works for Dennison and Uhrichsville are nearly completed. On May 16 the contract was let to Messrs. J. A. McCormick & Moran, of Pittsburg, Pa.; work was commenced May 22, and water was let into the reservoir on Oct. 7. The cast-iron pipe was furnished by the Addyston Pipe & Steel Co., of Cincinnati, O.; the hydrants and valves by the Ludlow Valve Co., of Troy, N. Y.; and the duplex pumping engines by Henry Worthington, of New York. The works are owned by the Dennison Water Supply Co., and cost about $120,000. The contract was for about 10 miles of pipe, which was afterwards extended about ½ mile; it was also found necessary to line the sides of the reservoir with brick. There are two pumping engines of 1,500,000 galls. daily capacity each, and a filtering gallery 190 ft. long from Big Stillwater to the receiving well at the pump house; this well is 25 ft. diameter and 24 ft. deep. The reservoir, which is located on Huston's hill, has a capacity of 3,000,000 galls.; it is 2,800 ft. from the pump house, and has a 12-in. rising main. There are 42 double nozzle hydrants in Dennison and 61 in Uhrichsville.

Water-Works. — ***New Hampshire.***—Keene. The water-works yielded a net income of $11,595 for the year ending Dec. 1, 1888.

Connecticut.—Stonington. The Mystic Valley Water Co. has completed its contract and the works were tested recently, with satisfactory results. The cost of the works will be about $150,000. Stonington will pay an annual hydrant rental of $1,500, and Mystic will pay $1,850.——Thompsonville. The water furnished by the water company has been analyzed and pronounced of good quality.

New York.—Buffalo. W. J. MCALPINE has presented plans and specifications for the proposed new reservoir on the Dodge farm. It is to be 1,500 ft. long, 600 ft. wide and 25 ft. deep, and is to be completed by Dec., 1891.

Pennsylvania.—Reading. The new ordinance providing for the introduction of the Maiden creek water supply has been amended so that the whole work shall be contracted for this year.——Mount Pleasant. A test of the new water-works has been made and the results were satisfactory. The stand-pipe is 80 ft. high and has a capacity of 105,000 galls.; it was filled by the duplex pumps in two hours.

Maryland.—Baltimore. The water has been turned on for the recently annexed western section. The water will probably be supplied by the Catonsville Water Co.

Virginia.—Roanoke.—The cost of repairing the reservoir of the water company will be about $5,000.

South Carolina.—Charleston.—The Carolina Construction Co. will lay a 15 in. main, 6,000 ft. long, to connect the old and new reservoirs.

Alabama.—Gate City. The Gate City Land Co., with which R. W. WARNOCK is connected, has made no arrangements for the construction of the water-works. The place is a suburb of Birmingham and will very likely obtain its supply eventually from the Birmingham water-works.

Tennessee.—Cleveland. The water-works committee has recommended that the city build its own works and appropriate $30,000 for the purpose.

Indiana.—Franklin. The City Council has contracted with a New York firm for a system of water-works with 6 miles of pipe and 60 hydrants. The annual rental will be $3,000.

Michigan.—Greenville. The system of driven wells has been tested and found to yield 507,000 galls. per day, or 7,000 galls. in excess of the quantity required by the contract with Geo. Waring.

Illinois.—Rogers Park. The Rogers Park Water Co. has been organized at Chicago, by H. E. KEELER, F. D. KEELER and N. A. PARTRIDGE; capital stock, $50,000.——Spring Valley. A new water tank has been erected for a fire supply.

Wisconsin.—Clinton. There are no works. The question was agitated about a year ago and then dropped.——Tomah. There are no works. There is a well with 600 ft. of water but no flow. C. P. QUIGG is mayor.——Union Grove. There is an artesian well, and it is proposed to put in an engine. T. G. BURHAM is Secretary.

Minnesota.—Ortonville. Bonds for $6,000 have been voted and when $4,000 more are voted a tank system of works will be put in.

Kansas.—Horton. The city has been advertising for propositions for a franchise for building and operating water works. Propositions were opened Jan. 2.

Montana.—Helena. A resolution has been referred to the Water Committte directing the Superintendent of Sewers, G. N. MULLER, to examine into and report upon the feasibility of the city building and owning a system of water-works.

Missouri.—Washington. The water company will cement its reservoirs this winter, instead of deferring the work to the spring. The works are nearly completed.

Texas.—Marshall. The contract between the city and E. Sutphin has been signed. The contractor is to furnish 500,000 galls. per day for 12 months after the completion of the works, which is to be in 6 months. The contract price is $67,000.——Temple. The two water companies have been consolidated. A pipe line will be laid to the Leon river.——Ennis. Water-works are projected, to be built during this year. Population 3,000. Address J. BALDRIDGE.——Trinity. There are no water-works, and none are contemplated. The International & Great Northern Ry. Co. is sinking an artesian well.

Oregon.—Portland. The supervisors will sell $100,000 more of 5 per cent. 30 year bonds to complete the city works.

Washington Territory.—North Yakima. Surveys are in progress for a water-works system.——Seattle. GEO. F. WOOLSTON, representing New York and Boston parties, has made a proposition to put in a $2,000,000 system of works, at a rental of $20,000, for 25 years.

California.—Santa Barbara. The Santa Barbara Water Co. has applied for a franchise.——San Rafael. It is proposed to build reservoirs and establish a system of water-works. The cost is estimated at $250,000.

Canada.—Chatham, Ont. The city having granted $40,000 to the Canadian Pacific Ry. Co., will probably not vote anything for water-works; if the company should lease the old Great Western line west of London, instead of building a new one, the town would be relieved from the bonus and a water-works project might be taken up.

Special Reports of Water-Works Construction.

Crewe, Va.—We have received the following information regarding these water-works, from H. C. MACKLIN, Engineer of the Norfolk & Western R. R. Co., of Roanoke. Water-works were put in operation in July, 1888, one month after beginning their construction. The pumping machinery and tanks were furnished by the Norfolk & Western R. R. Co., and the pipes and specials by the Glamorgan Co., of Lynchburg, who also did the trenching and pipe-laying. Hydrants, Mathews. Valves, Chapman. A Gordon steam pump with a daily capacity of 225,000 galls. pumps the water from a spring, through 4 miles of 6 and 4-in. cast-iron pipe, direct to services, which are of ½ and ¾-in. galvanized wrought-iron, and also to two tanks, with a total capacity of 100,000 galls. There are 15 hydrants, and the average daily consumption is 70,000 galls. The works are owned by a company, of which MALCOLM W. BRYAN, of Roanoke, is the Superintendent. No further data given.

We have received from CHAS. F. LOWETH, St. Paul, Minn., the following data regarding water-works at Austin, Minn., and Cedar Falls, Ia. Mr. LOWETH was engineer for both systems.

Austin, Minn.—The works were built by the town in 1887 and put in operation in 1888. The contractors for all labor and materials were the National Iron & Brass Works, Dubuque, Ia., who made the pumps, which are of the Smedley pattern, and bought the pipe of the Detroit (Mich.) Pipe Works, and Lake Shore Foundry Co., Cleveland, O.; also hydrants of R. D. Wood & Co., Philadelphia, Pa. Water for domestic supply is pumped direct from an artesian well, and for fire purposes from Cedar river. There are 4.4 miles of mains. The works have cost $36,757. Population 4,500.

Cedar Falls, Ia.—The works were put in operation July 1, 1888, and are owned by the town. The contractors were the American Water & Gas Works Construction Co., Dubuque, Ia. Water is carried from springs through 1,100 ft. of wooden conduit to the pump-well from which a 1,000,000-gall. Worthington duplex high pressure pump lifts water to a tank 20 by 30 ft., on an iron pier 75 ft. high. The tank was built by WM. LEE, St. Paul, Minn. There are 3.7 miles of 4 to 10-in. cast-iron pipe, and 31 Mathews hydrants. Pipe and specials were furnished by Shickle, Harrison & Howard, St. Louis, Mo. The works cost $33,100. Population, 3,500.

ALEXANDER, Ark., Dec. 20, 1888.

EDITOR ENGINEERING NEWS:—The Alexander Water-Works Co. has put in a small gravity system of water-works, taking the supply from springs through 1,440 ft. of 1¼-in. iron pipe. The works cost $250, and are used chiefly by the stockholders. T. H. BERRY, is Superintendent.

ESTEN PELAUBET, *President.*

PORTERSVILLE, Cal., Dec. 14, 1888.

EDITOR ENGINEERING NEWS:—The water-works will probably be put in operation to-morrow (the 15th). Work was begun in August. They were built by the Pioneer Land Co., of which WM. THOMAS, 206 Sansome St., San Francisco, is President, with E. NEWMAN as designing and constructing engineer, at a cost of about $9,500, which was raised by assessing the stockholders of the company. The supply is taken from the company's ditch, (a ditch taken out of the Tube river, 8 miles above town, the water being used for irrigation,) and is pumped to a stand-pipe and reserve tank by a pump furnished by the Atlas Iron Works. Pipes and specials were furnished by FRANCIS SMITH, both of Santa Fé. The water is filtered from the ditch to a well and from there pumped into a large air chamber, connected with the main, and pipe to reserve tank. The pump is driven by a LEFFEL mining wheel of 33 H. P., on a horizontal shaft. The cost of the wheel, laterals and house connections is not included in cost given above. Population of the town is about 600. E. NEWMAN.

MILTON, Oregon, Dec. 18, 1888.

EDITOR ENGINEERING NEWS:—The construction of a gravity system of water-works was begun in July, by JOHN O'BRYAN, and completed in October, 1888. J. CORKISH, 311 Morrison St., Portland, was the constructing engineer. Pipes and specials were furnished by the Puget Sound Wood Water Pipe Co., of Olympia, W. T., and the hydrants are of the Holly pattern. The supply is obtained from the Walla Walla river, and conveyed through one mile of 12 to 6-in. wooden pipe to the town; services are of galvanized iron. We have 25 taps, 4 hydrants and an ordinary pressure of 24 lbs. The cost of the works was $5,000, which amount was met by issuing $5,000 of 8 per cent. bonds. The works are owned by the town, which has a population of 600.

A. ALLEN, *Superintendent.*

150 First Ave. PITTSBURG, Pa., Dec. 20, 1888.

EDITOR ENGINEERING NEWS:—The construction of a system of water-works to supply Dennison and Uhrichsville, O., (total population 7,000) was commenced May 27, and works were put in operation Oct. 7, 1888. The general contractors were McCormick & Moran, of Pittsburg. The two 2,500,000-gall. pumps and the meters were furnished by H. R. WORTHINGTON, of New York. Pipes and specials by the Addyston (O.) Pipe & Steel Co., and the valves and hydrants by the Ludlow Valve Mfg. Co., of Troy, N. Y. Water is pumped from the Big Stillwater river to a reservoir of 3,000,000 galls. capacity. There are 10¾ miles of pipe, 103 fire hydrants, and the average daily consumption is 500,000 galls. Ordinary and fire pressure, 80 lbs. The works are owned by the Dennison (O.) Water & Supply Co. The officers are: C. S. SIMMS, President; C. B. STREET, Vice-President; M. MOODY, Secretary and Treasurer. The franchise is for 15 years, with a yearly hydrant rental of $40 for each hydrant. They were built at a cost of $120,000. Annual revenue from city is $3,700.

MORAN & MCCORMICK.

SUPERIOR, Neb., Dec. 28, 1888.

EDITOR ENGINEERING NEWS:—Water-works will be finished Jan. 15, 1889, by the village with S. H. FILTON, Omaha, as contractor. Water is pumped from a well on the river's bank to a reservoir. The cost will be $20,000. Population, 2,500. CHAS. E. DAVIS.

MISSOURI VALLEY, Ia., Dec. 24, 1888.

EDITOR ENGINEERING NEWS:—The Council has just given a 20 years' franchise for water-works to J. S. WATTLES, of this place. Have no doubt but that the works will be built next summer. J. S. MCG.

WASHINGTON, Mo., Dec. 24, 1888.

EDITOR ENGINEERING NEWS:—The Inter-State Gas & Water-Works Co. has nearly finished its works here. Water is pumped from the Missouri river to a 100,000-gall. stand-pipe, 12 ft. in diam. and 125 ft. high. The Pond Engineering Co., St. Louis, Mo., furnished the pumping machinery. There are 4½ miles of 8 to 4-in. mains. The franchise is for 20 years, and the hydrant rental $60 each for 50. W. H. HAZLEHURST.

NESS CITY, Kan., Dec. 26, 1888.

EDITOR ENGINEERING NEWS:—The City Council will have plans for water-works made in the coming summer and receive bids for their construction. Water will be taken from Sunset lake, which is fed by large springs. Our present supply is from wells and small water-works in Kenwood addition. The estimated cost of the works is $25,000, and bonds have been voted for their construction. Population, 1,165. ROSS CALHOUN.

WAXAHACHIE, Tex., Dec. 28, 1888.

EDITOR ENGINEERING NEWS:—Plans and specifications for water-works will be finished by our engineer in Jan., 1888, and will be acted upon by the Council. Upon their adoption we will advertise for bids. Population, 3,500.

E. A. DU BOSE, *Mayor.*

WINTER HARBOR, Me., Dec. 28, 1888.

EDITOR ENGINEERING NEWS:—The Winter Harbor Water Supply Co. proposes to build works, beginning Apr. 1, and finishing July 1, 1889. The supply will be from Birch Harbor Pond, by gravity, and the cost is estimated at $15,000. ERNEST BOWDITCH, Boston, is engineer for the company; D. B. FLINT, Commonwealth Ave., Boston, President. Our population is 800.

B. E. TRACEY, *Secretary.*

ST. LOUIS, Mo., Dec. 23, 1888.

EDITOR ENGINEERING NEWS:—Water-works were put in operation Nov. 1, 1888, at Morrisonville, Ill. They are owned by the village, the population of which is about 1,100. F. W. RAEDER, was engineer for parts of the work, and GRANT TILDEN, contractor. The pumping machinery and boilers were furnished by M. O. Nelson & Co., and the pipes and specials by Shickle, Harrison & Howard Iron Co., all of St. Louis, Mo. The labor was done by the day. Water is pumped from a well to a tank. The pump is duplex, with a daily capacity of 500,000 galls. The tank is of cypress, 20 ft. in diam. and 16 ft. high, placed on a timber trestle 60 ft. high. There are 1,400 ft. of 8 to 4-in. cast-iron pipe, and four Ludlow hydrants. Cost, $7,000. F. WM. RAEDER.

Pipestone, Minn.—JNO. H. WOOD, Secretary of the National Iron & Brass Works, Dubuque, Ia., sends us a description of the works built by that company for Pipestone, after plans by EDWIN SMEDLEY. Water is pumped from a bored well, 6 ins. in diameter and 200 ft. deep, to a stand-pipe, 12½ ft. in diameter, and 100 ft. high, furnished by the Shickle, Harrison & Howard Iron Co., St. Louis, Mo. A 25-ft. Halliday wind-mill drives a deep-well pump of 3½-in. bore and 18-in. stroke. There are 2 miles of 8 to 4-in. cast-iron mains, a few taps, no meters, 10 Chapman hydrants and some Scott valves. The works cost $20,000. C. C. GOODMAN is Chairman of Water Committee.

AURORA, Neb., Dec. 26, 1888.

EDITOR ENGINEERING NEWS:—Our water-works will be finished about Feb. 1, 1889. They were designed by W. KIERSTED, Kansas City, Mo., and constructed under the direction of L. D. MAY, of Lincoln. GEO. W. DANIELS was contractor for masonry foundations and reservoir. The pumps were furnished by the Cook Well Co., St. Louis, Mo., and the Dean Pump Co., Holyoke, Mass., and the boilers by M. H. Walker & Co., Chicago, Ill. Pipe and specials are from the Chattanooga (Tenn.) Foundry & Pipe Co., and were laid by Lowrie Bros., Aurora. The stand-pipe was made by the Porter Mfg. Co., Syracuse, N. Y., and water from the wells discharges into a reservoir from which it is pumped by a 750,000-gall. Dean pump to a stand-pipe with a capacity of 63,000 galls. There are 13,000 ft. of 10 to 6-in. mains and 22 hydrants. The works will cost $25,000.

WM. R. HELLINGS, *City Clerk.*